From several Experiments made by Mr Gray it appears, that the Scotch pint
contains 103.4, Inches at first & 197.34, and the Bear first of 2150.4 ~~Cubic~~
~~Inches~~ Cubic Inches: That the Scotch ounce is equall to
476 Troy grains, or four grains less than the English Troy ounce: That the
Scots foot is equall to 12.1, and the Scotch Ell, according to the Standard
of Edr, equall to 37.26 English Inches: That the Scotch Mile Contains
5952 English feet, and the Scotch Acre 55353.6 Square feet According
ing to the Description given in the Monthly Review, for Sept.r England

JG-E

MSS
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see II, 73 top

William Walker

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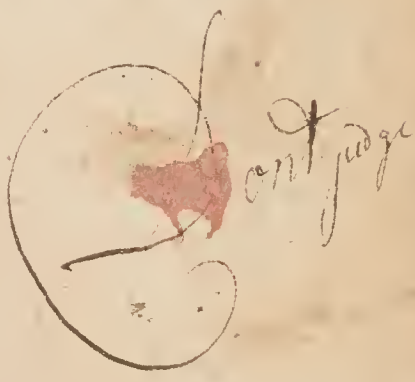
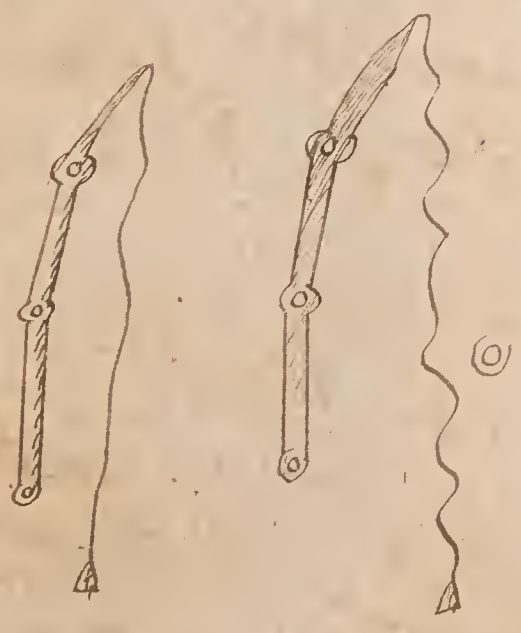
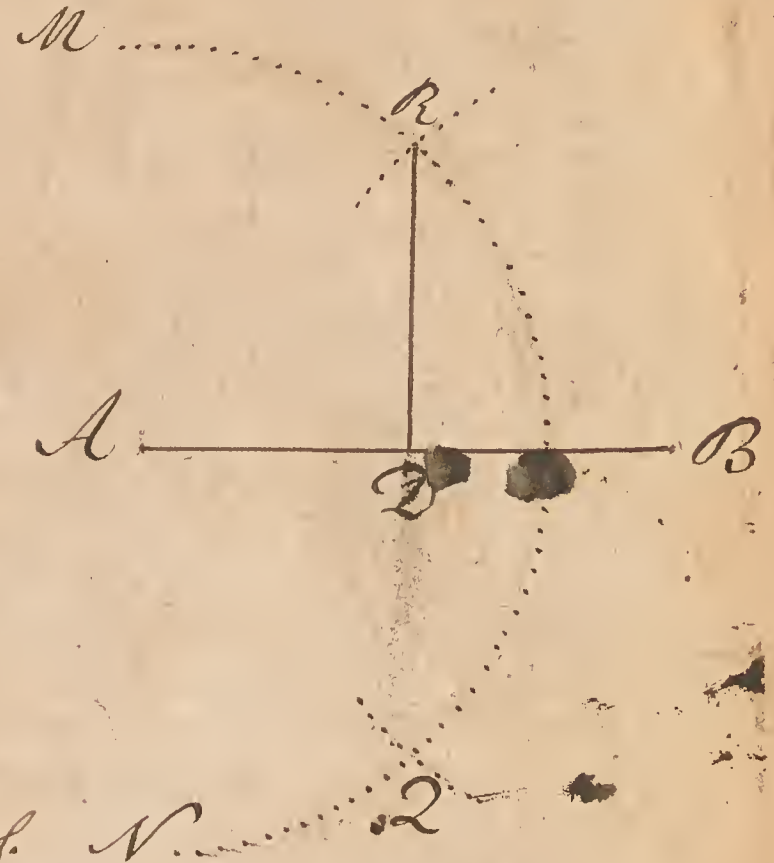


William Walker



Geometrical Problems for the Construction of Dials.

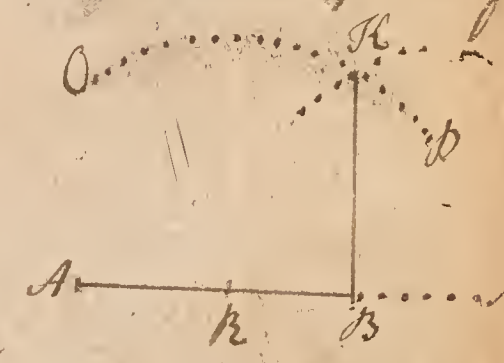
Problem 1. To erect a perpendicular upon the midle of a Line, and so divide that line into two equal parts.



Let the given Line be A B.

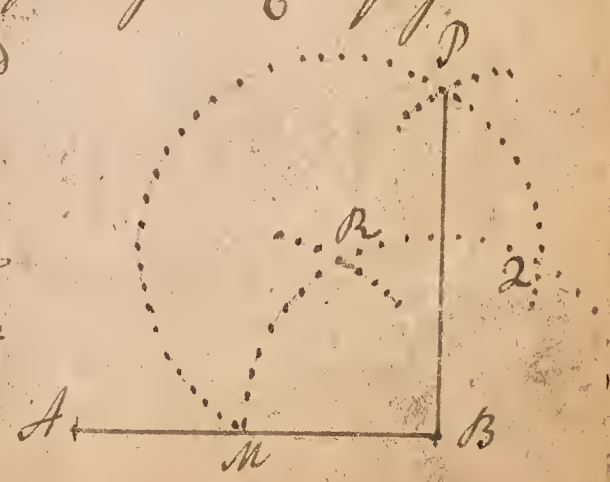
Open your Compasses to more then half the given Line, & setting one Foot on A, w the other describe the Arch M N; then, your Compasses remaining at the same wideness, set one Foot on B, and with the other intersect ye Arch M N at R & 2, and laying a Ruler on the two Points of intersection R & 2 draw a Line cutting A B at D: So shall R D be perpendicular to the given Line A B, & in the midle thereof.

Prob: 2. To erect a Perpendicular upon the end, or extream point of a Line.

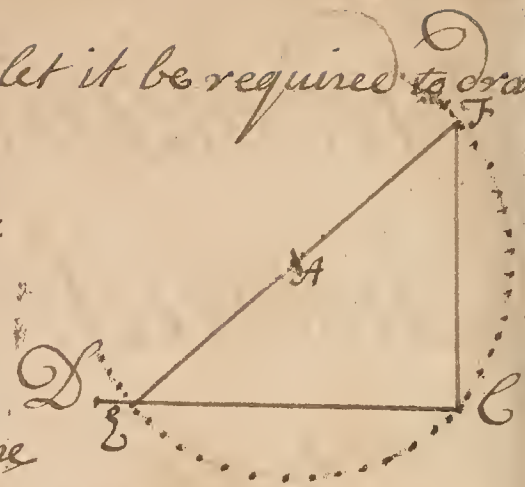


Let the given Line be A B. Continue the Line A B from B to N, and mark that distance from B to R upon the Line B A; then open your Compasses to any convenient wideness, and setting one Foot on N, with the other describe the Arch O P, then, your Compasses remaining at the same wideness, set one Foot on R and with the other intersect that Arch at K, & draw K B, which shall be perpendicular to the Line A B, & upon the extream point B.

Another way. Let the given Line be A B. Open your Compasses to a convenient wideness, and set the one Point in B, and with the other describe the Arch M 2; then setting one Foot on M, with the other intersect that Arch in R; then, placing one Foot in R, with the other describe ye Arch M P 2; then, setting one Foot on 2, intersect that Arch in P, and Draw P B, which shall be perpendicular to the Line A B, and on the Point B.

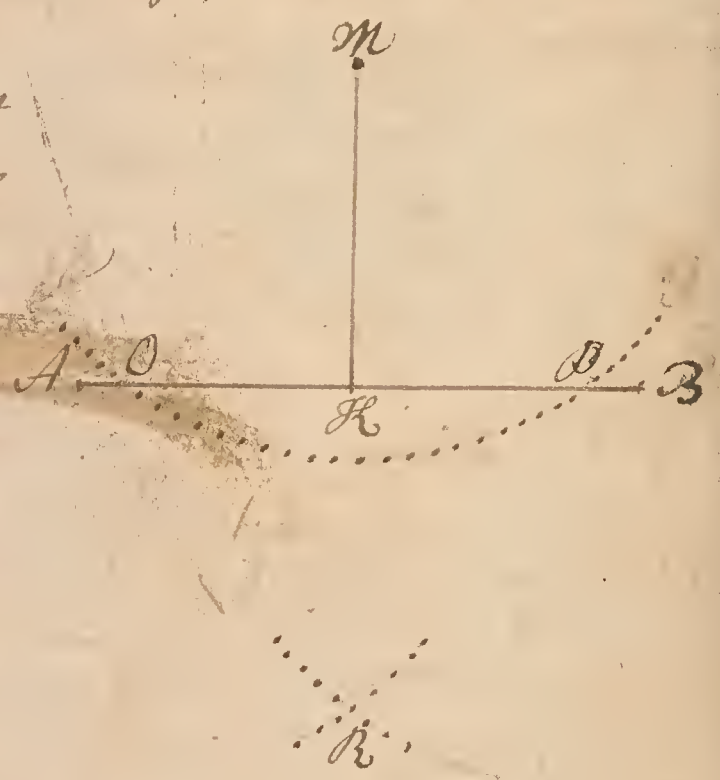


Another Way. Let the given Line be C D, & let it be required to draw a Perpendicular Line to the Point C; your Compasses being opened to any reasonable distance, set one Foot on the Point C, and the other in any place on either side the Line C D, suppose at A, then discribe the Arch E C F, this done draw the Line E A, and where that Line being extended shall cut the Arch E C F, a Right line drawn from C to that intersection shall be Perpendicular to the point C in the Line C D.



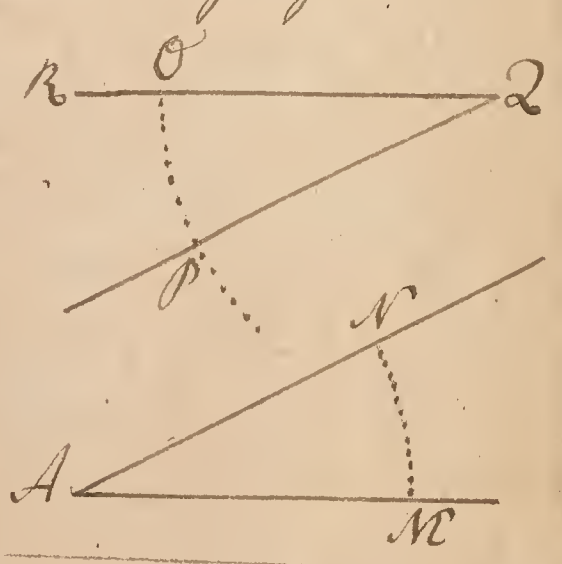
Prob: 3. From a point assigned above a right Line, to let fall a perpendicular to the right Line.

Let the given Line be A B and the point assigned M. Open your Compasses to reach beyond the given Line, then from the Point M, and upon M, as Center, describe the Arch O P; then upon O & P setting your Compasses make two Segments of Arches intersecting one another in K, and draw M K; So shall M K be a Perpendicular to the given Line, and pass through the Point M.



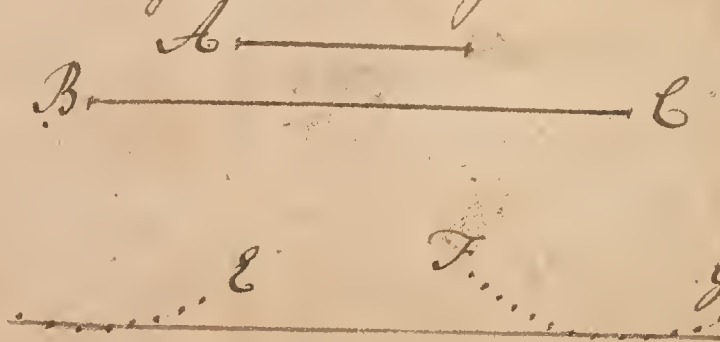
Prob: 4. To make an Angle equal to an Angle given.

Let the given Angle be the Angle A. First, upon the Angular point A describe an Arch, as M N; then draw a Right line as 2 R, and upon 2 describe the former Arch as O P, and set the Arch M N from O to P, and draw the side 2 P; so have you made an Angle equal to the Angle given.



Prob: 5. To run a line parellel to a line given, & at any distance required.

Let the given line be B C, and the distance between y Parellel lines the length of the line A. First, open your Compasses to the length of the line A, and placing one Foot on B with the other describe the Arch D E;



Again

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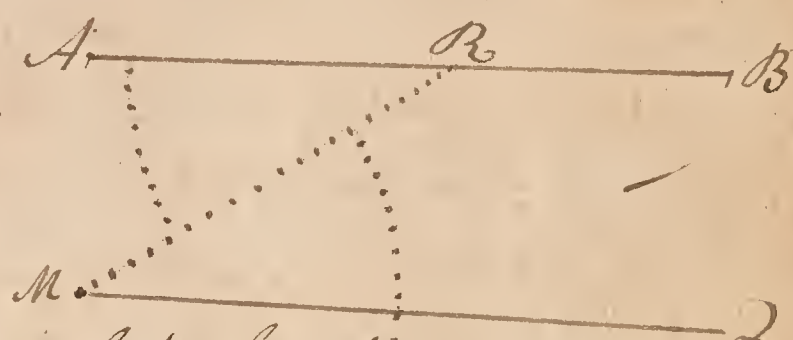
RB NMAH

Again, setting one foot on C, with the other discribe the Arch F G; Lay a Rule over the Summits of these Arches, and draw a right Line, which shall be parellel to the line B C, and at the distance requiree.

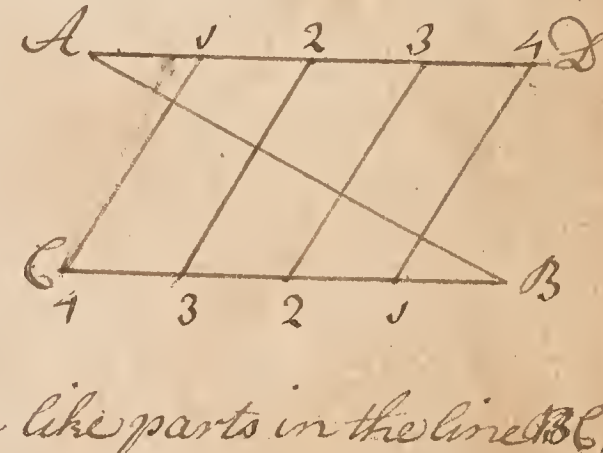
Prob: 6. To run a line parellel to a Line, given & through a Point assignee.



Let the given line be A B, and y point assignee M. From the Point M draw a Line to fall any where upon the Line A B, as M R; then make an Angle upon the point M with the line M R equal to the Angle A R M, by Prob: 4, and make the line M 2 which shall be parallel to the given Line and pass through the Point M.

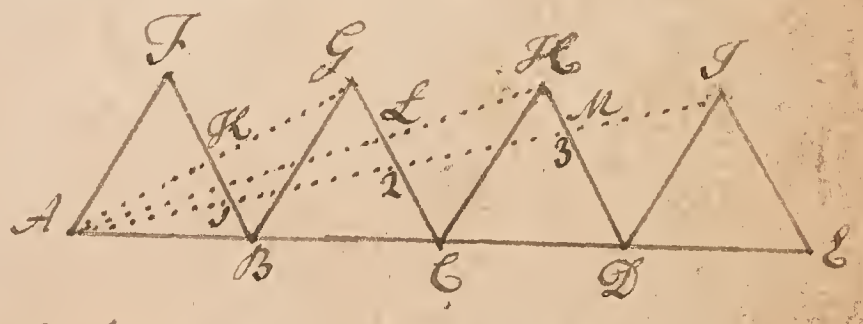
Prob: 7. To divide a right line given into any Number of equal Parts.

Let it be requiree to divide the right line A B into 5 equal Parts.

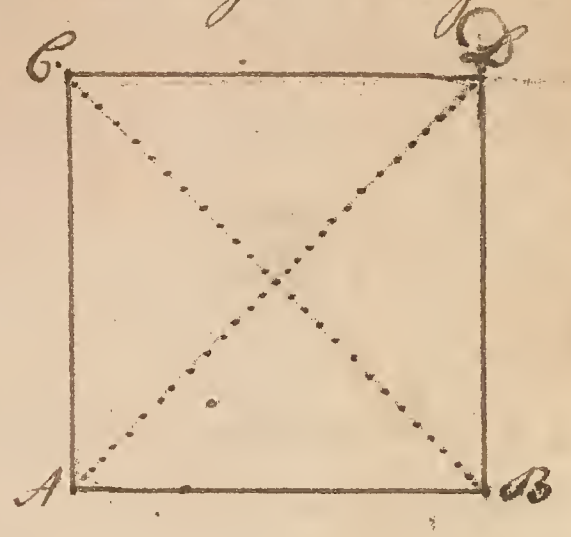


From the extream Points of the given Line A and B draw two parellel lines by Prob: 6, then from the point A, at any distance of the Compasses, set off as many equal parts wanting one, as the given Line is to be divided into, which in this Example is four, and are marked thus, 1, 2, 3, 4; and from the Point B set off the like parts in the line B C, and let them be likewise marked 1, 2, 3, 4, as in this Figure; then shall the Parellel lines 1 4, 2 3, 3 2, 4 1 divide ye right line A B into 5 equal parts.

Another way. Let it be required to divide the line A B into four equal parts. Produce the line A B, and run out upon it the 4 equal Parts A B, B C, C D, D E, and continuing the same Aperture of the Compasses upon these equal Parts raise the four Equilateral Triangles A F B, B G C, C H D, D I E; then draw the right Lines A G, A K, A I; and then the Line K M will represent one of the four equal Parts of the given Line A B, and ye Line D M will represent 3/4, and Line F K or B K will represent two of y^m. But the line A I is sufficient alone; for it cuts the Line B 1 equal to y^e fourth, and the Line C 2 equal to the half, & the Line D 3 equal to 3/4 of the given Line A B.

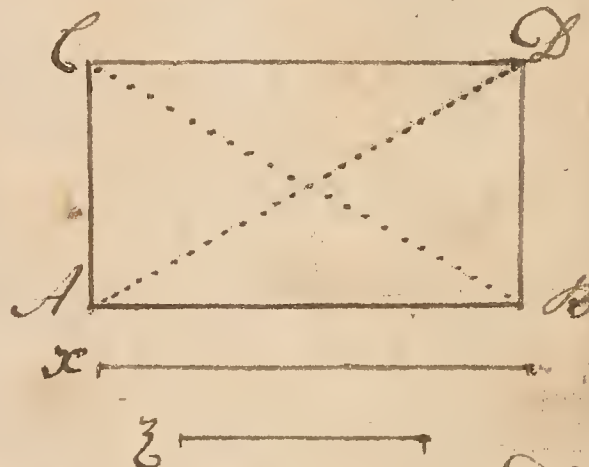


Prob: 8. To make a Geometrical Square whose side is given.



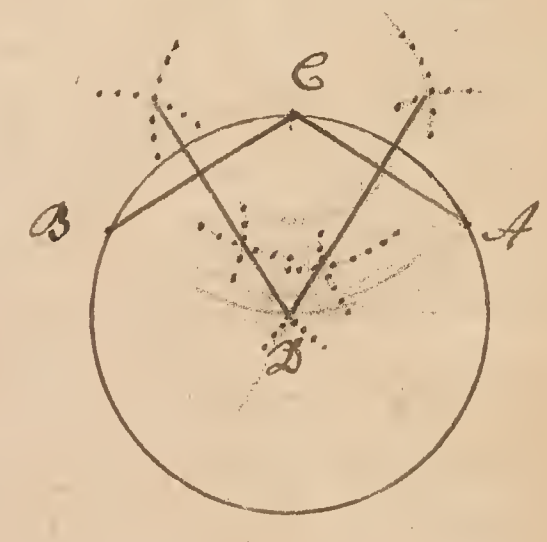
Let the given Line be A B. Upon the point A erect a Perpendicular A C (by Prob: 2) at the distance A B; with the same distance of your Compasses from C as Center draw an Arch, and from the Point B as Center draw another Arch crossing the former at the point D; then draw the Lines C D and D B, and it is done. Lines drawn to the opposite Angles as A D & B C are called Diagonals.

Prob: 9. To make an Oblong, or Parellelogram, having the length & breadth given.



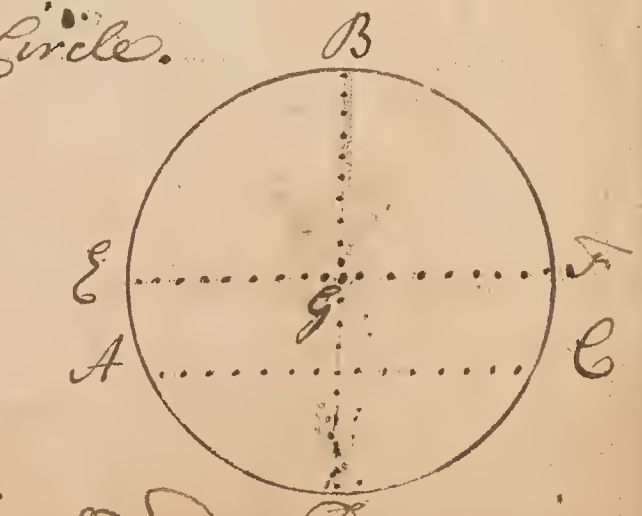
Let the length given be x, and the breadth z. Draw the Line A B equal to x, upon the Point A erect the Perpendicular A C equal to z; from C as Center at the distance of A B describe an Arch, then from B as Center at the distance A C describe another Arch cutting the former at the Point D, then draw the Lines C D and D B, and it is done.

Prob: 10. To Describe a Circle, whose Circumference shall pass thro' any three Points given not in a right line.



Let the three points given be B, C, A. Draw the right Lines B C and C A, and then (by Prob: 5.) divide each of these Lines by Perpendiculars into two parts, continue these two Perpendiculars till they cut one another at D, and that will be the Center of the Circle required.

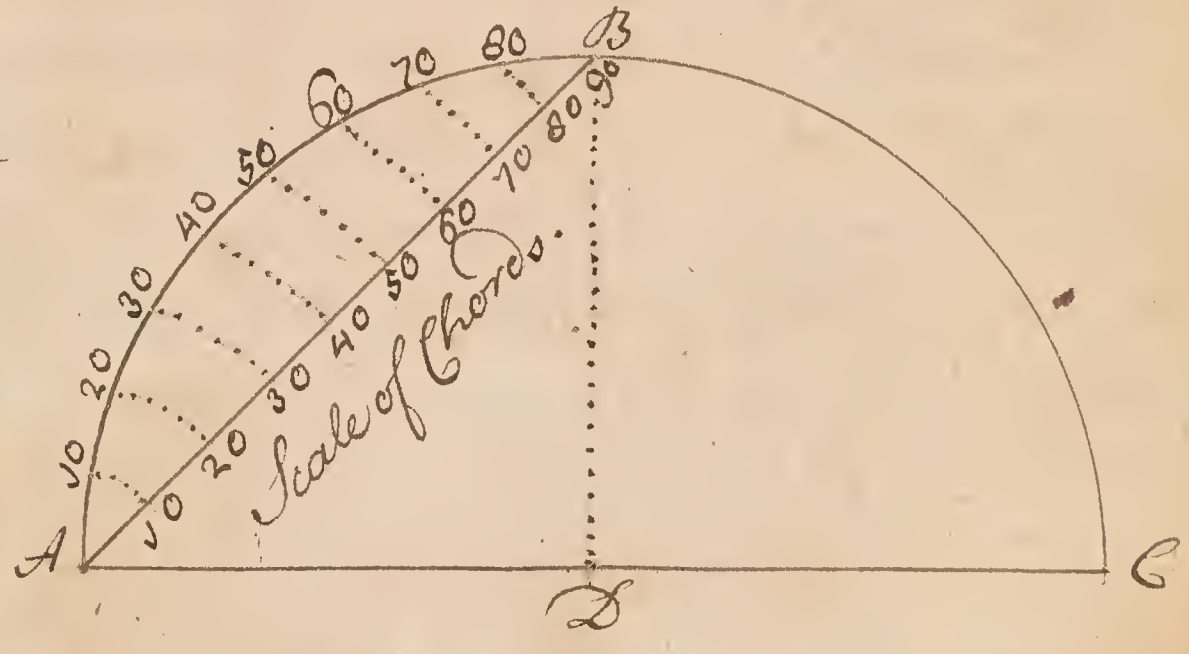
Prob: 11. To find the Center of a Circle.



Let the given Circle be A B C. Bevisect any two points of y Circumference Draw a right Line as A C, upon which (by Prob: 5.) erect a Perpendicular dividing it into 2 equal Parts which will be y Diameter B D; do the same upon B D, & draw the Line E F, and G y Point of intersection is the Center.

Prob: 12. To make a Line of Chords.

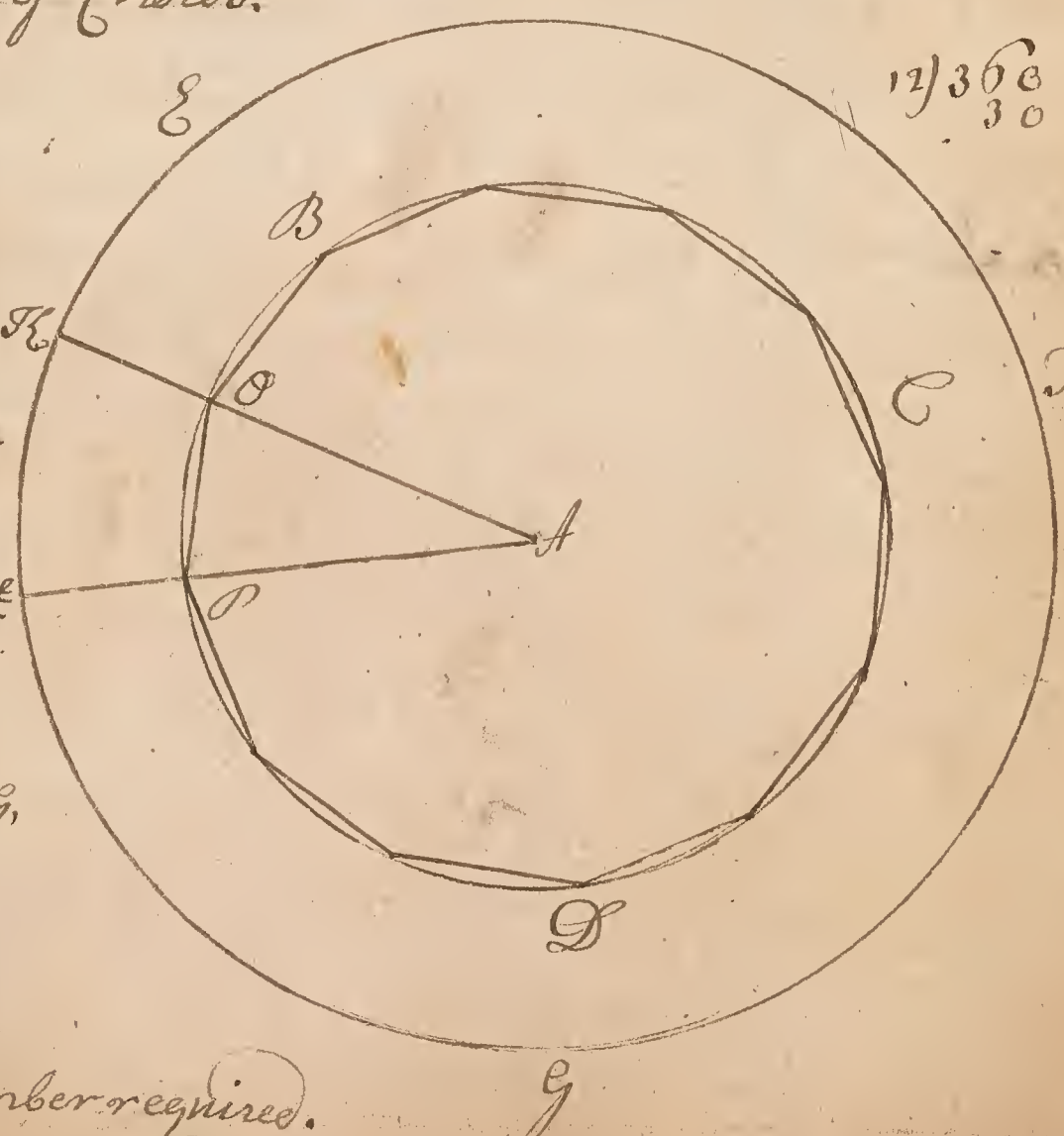
First describe a Semicircle, as A B C D, the larger the bet:ter, divide it into two Quadrants, as A B D and B D C, that done, draw a Line from A to B, take the Radius of the Semicircle in your Compasses, and placing one Foot on A, with the other in:tersect the Quadrant at 60, so is B 60 one third of the Quadrant, by which means the Quadrant is divided into 3 equal Parts; then divide each of these into 3 other e:qual parts, so is the Quadrant divided into 9 equal parts; Subdi:vide each of these equal parts into 10 equal parts, so have you the Quadrant divided into 90 equal parts: that done, set one foot of the Compasses on A, and open up to each of the divisions in the Quadrant A B, transferring each of these extents to the right Line A B, so is y Line A B a line of Chords, which must be divided into 10, 20, 30, 40, 50, 60, 70, 80, 90, as in the Figure.



Prob: 13. To divide any Circle into any Number of equal parts by help of the Line of Chords.

Let the Circle A B C D be given to be divided into 12 equal parts. First, upon A the Center of the given Cir:cle discribe another Circle as E F G with 60° from ye Line of Chords; then divide 360 by 12 ye Num: of equal parts into wch ye given Circle is to be divided, y^e Quot wch is 30 take off fr^m y^e line of Chords & lay upon y^e Circle E F G, as at K & L, & draw y^e Lines A K & A L, wch will cut y^e given Circle at O & P, wch will di:vide y^e same into y^e Number required.

12)360
30



Of Dialing.

Dials take their Names from the situation of the Plane, on which they are drawn. If the Plane be level, or Parallel to the Horizon, a Dial discribed thereon is called a Horizontal Dial: But if the Plane be perpendiculer to the Horizon, such Dials are called Erect Dials; and if ye Plane face directly to the South, North, East, or West parts of ye Horizon, then such Dials are called Erect Direct South, North, East, or West Dials.

The Geometrical construction of an Horizontal Dial for 57° 10'. N: L:

First, with the Chord of 60 Degrees on your Compasses, set one Foot on Z, the Center of the Dial, and describe a circle, representing the Dials Plane and Horizon of the place, and cross it with two cross Diameters at right Angles in the Center, the one marked N: S: (i.e. North, South) for the Meridian or twelve a Hour Line, and the other with W: E: for the West & East or 6 Hour Line. Then Let it be required, for Example, to draw a Dial for the Latitude of 57° 10' North; Take the Latitude of the place from the Scale of Chords, and lay upon the primitive circle from W: toward N: at B, and from S: towards E at A; Lay a Ruler upon E: and B, to cut the 12 Hour Line at Æ; through the three points W: Æ and E draw a circle representing the Equinoctial; again lay a Ruler upon A & W, to cut the 12 Hour Line at P the Pole of the World; Divide the Semi-circle from W by N to E into 12 equal parts; lay a Ruler upon Z and each of these Divisions, to cut the Equinotial in x x x &c; then lay a Ruler upon ye Pole of the World and upon each of these Points marked x, and it will cut the circle of the Plane in the Points 1, 2, 3 &c on the right hand of the 12 Hour Line, and 11, 10, 9 &c on ye left side thereof: Lastly, lay a Ruler on Z and each of the Points marked 1, 2, 3 &c, and draw the Hour Lines as in the following Figure.

Take the Latitude of the Place, and lay upon the Plane from N to O; then draw a Line from O to Z for the Stile or Gnomon, and fashion it as in the Figure.

N. B:

N: B: The Stile must stand upon the 12 Hour Line, making an Angle therewith equal to the Latitude of the Place, which is equal to the Poles Elevation above the Horizon.

An Horizontal Dial.

N: B: The Hour distances of an Horizontal Dial for 51° 10' North Latitude are as follows;

	Deg:	Min:
For the Hours of 1 in the Afternoon & 11 in ye Forenoon	12	42
For the Hours of 2 in the Afternoon & 10 in ye Forenoon	25	52
For the Hours of 3 in the Afternoon & 9 in the Morning	40	03
For the Hours of 4 in the Afternoon & 8 in the Morning	55	30
For the Hours of 5 in the Afternoon & 7 in the Morning	72	20

The Geometrical Construction of an Erect Direct South Dial for 57° 10' N: Lat:

The Construction or making of this Dial Geometrically is the same in all respects as in the Horizontal Dial, only proceed with the * Compliment of Latitude instead of the Latitude itself. Thus, having described the Circle, and marked the extream Points of the two Diameters with Capital N, S, W, E, for the North, South, West & East, take the Compliment of Latitude for this Example, which is 32° 50', from the Line of Chords, and lay upon the Circle from W: towards S: at B; lay a Ruler upon E: and B, to cut the Meridian or 12 Hour Line at Æ; and through the Points W: Æ: E: draw the Equinoctial Circle; again take the Compliment of Latitude, Viz 32° 50', and lay upon the primitive Circle from N towards E at A; then lay a Ruler upon W: and A, and draw a Line cutting the Meridian, or 12 Hour Line, at P the Pole of the World. Having found the Equinoctial & Pole, proceed in all respects for the Hour Lines as on the Horizontal Dial; only observe, if there is no Hour Lines drawn upon this Dial after 6 at Night & before 6 in the Morning.

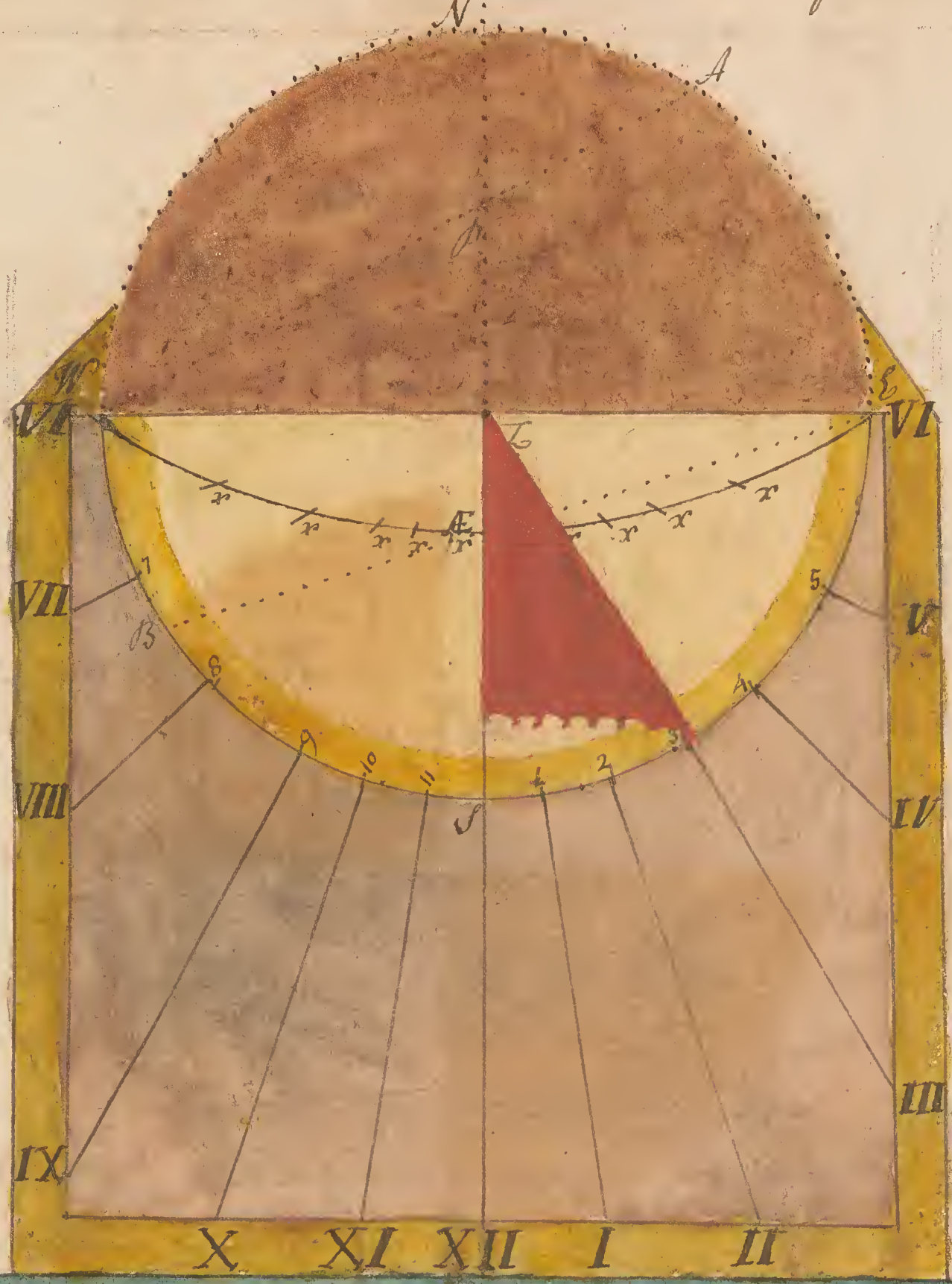
N: B: The Gnomon stands upon the 12 Hour Line, making an Angle therewith equal to the Complement of Latitude; pointing downward to the South Pole.

* The Complement of Latitude is the Latitude subtracted from 90.

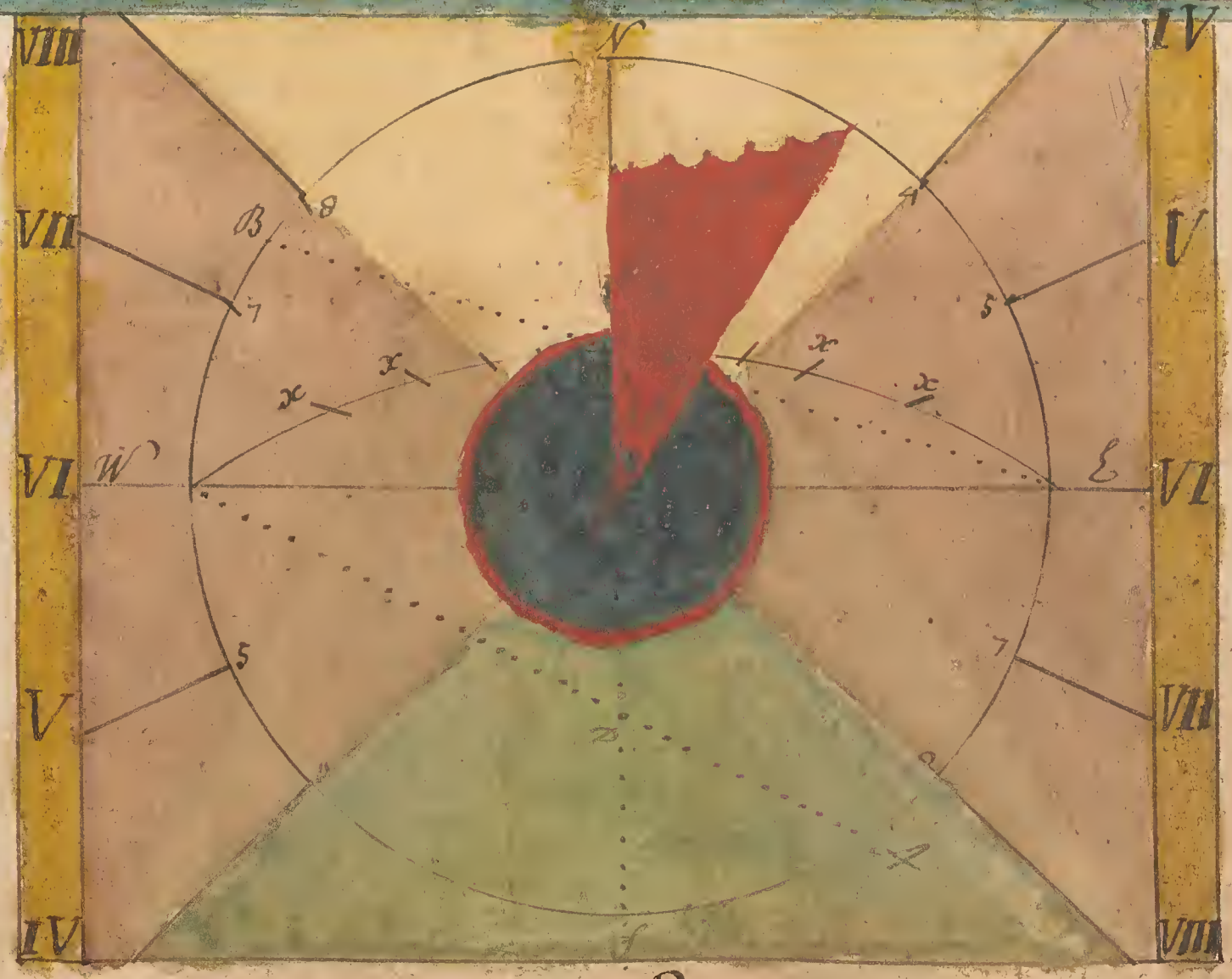
The Geometrical Construction of an Erect Direct North Dial, for 57° 10' N: Lat: is the same as the preceeding Dials:

Only the stile must be placed towards the North Pole, making an Angle with the 12 Hour Line equal to the Complement of Latitude; and the Hours near midnight, Viz 9, 10, 11, 12, and 1, 2, 3 in the Morning, may be left out, the Sun never shining at these Hours in this Latitude. The Equinoctial & Pole are found in all respects as in the Horizontal Dial, only making it with the Complement instead of the Latitude.

An Erect Direct South Dial for 57° 10′ N. Lat.



An Erect Direct North Dial.



57° 10′ North Latitude.

The Geometrical Construction of the East and West Dials for 57° 10′ North Latitude.

First, let A B C D be the plane on which the Dial is to be drawn; upon D, or any where toward the lower end of the line B D, with a Chord of 60 set one Foot of your Compasses on D, and with the other describe the Arch h b, cutting the line C D in h; take the Complement of Latitude, viz 32° 50′, and lay upon the Arch from h to b, and draw the Equinoctial line D b E; that done, toward the upper end thereof assume the point P, through which draw the line VI P VI perpendicular to the Equinoctial; assume another Point toward the lower end of ye aforesaid D b E at G, and through G draw a line parallel to the 6 Hour Line, as XI G XI for the 11 Hour line, take the Chord of 60 in your Compasses, and setting one Foot on G, with the other describe the Arch o t cutting the Equinoctial at o; take the Chord of 15 Degrees and lay thereon from o to t, and draw the line G m R cutting the 6 Hour line in n; upon n as a Center, with the Chord of 60 in your Compasses, describe the Arch k i cutting the 6 Hour line in k and the line G m R in i; divide the Arch k i into 5 equal parts at the points z, z &c, lay a Ruler upon n & each of these Points to cut the Equinoctial at x x &c; lastly, thro' each of the points x x &c draw lines parellel to the 6 Hour line, which will be the Hour lines of 7, 8, 9, 10, the Hours of 6 & 11 being already drawn. The Hours of 4, 5 in ye Morning before 6 retain ye same distance from ye 6 Hour line as the Hours of 6, 7, &c. The stile must stand on the 6 Hour Line, the height of it being equal to n p. The East & West Dials are ye same in all respects, only the Construction is on opposite sides.

To draw an Hanging Dial on a Card for 57° 10′ N: Lat:

1st. Draw an Horizontal line at some distance from the end of the Card, towards the left hand marked 12, for the 12 Hour line; with the Chord of 60 in your Compasses place one Foot in 12, and with the other draw an Arch from the Horizontal line upwards as B A; lay the Chord of 57° 10′ thereon as C, and from 12 to the end of the Arch draw a line to D, and from the Point where the Semidiameter cuts the Arch let fall a Perpendicular to the Horizontal Line for the Hour of 6.

2. Then with the distance of 6 to 12, upon 6 as Center draw a Circle, and divide each Quadrant in to 6 equal parts, and draw parallels Lines to the 6th Hour line for the Hour lines, and Number them as you see in the Figure.

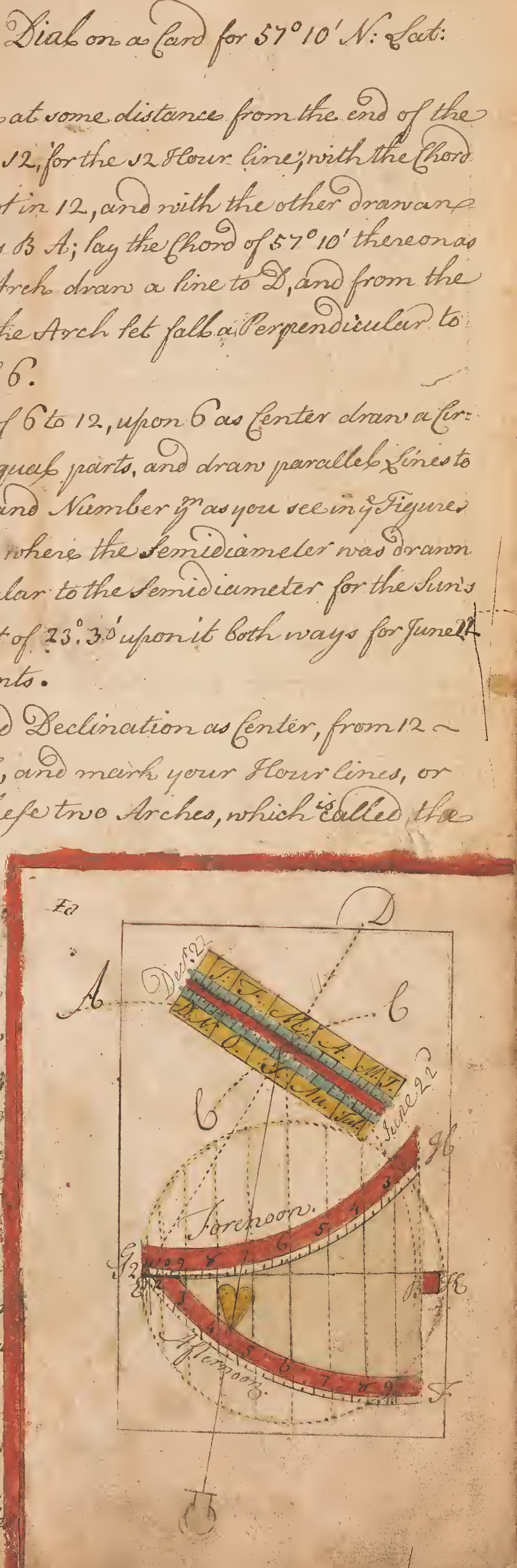
3. Upon the forsaid point, where the Semidiameter was drawn to cut the Arch, erect a Perpendicular to the Semidiameter for the Sun's Declination, and set the Tangent of 23°. 30′ upon it both ways for June 22 & December 22 the two Solstitial points.

4. Upon the one and Head Declination as Center, from 12 draw two Arches E F, and G H, and mark your Hour lines, or draw them Blank only, between these two Arches, which is called the Play of the Heart.

The Use,

Hang your Plumb line to the Day of the Month proposed, and draw the Point of the Heart to the 12th Hour, then hold the Card between your Finger & Thumb, so that the shadow of the lifted Gnomon K, cut in form of an Oblong, may shew along the Horizontal line at least to the 6 Hour, then notice what Hour or Quarter the point of the Heart touches; for that is the Hour of the Day.

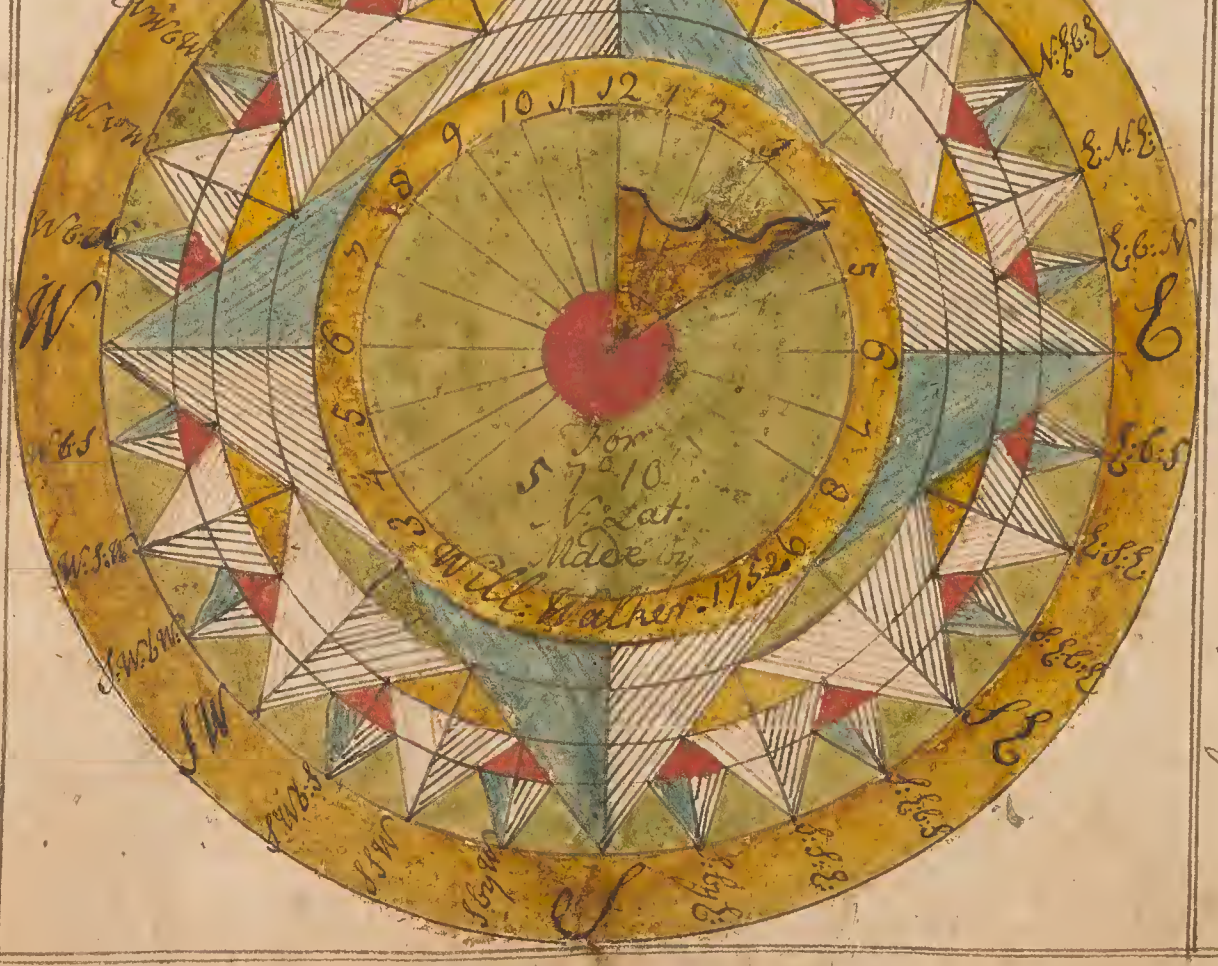
N: B: The line of Declination is to be cut out to a thin slitt, to let a slider move for the fixing the Plumb to. The Hours may be divided into ½ or ¼ at pleasure



To draw a Meridian Line.

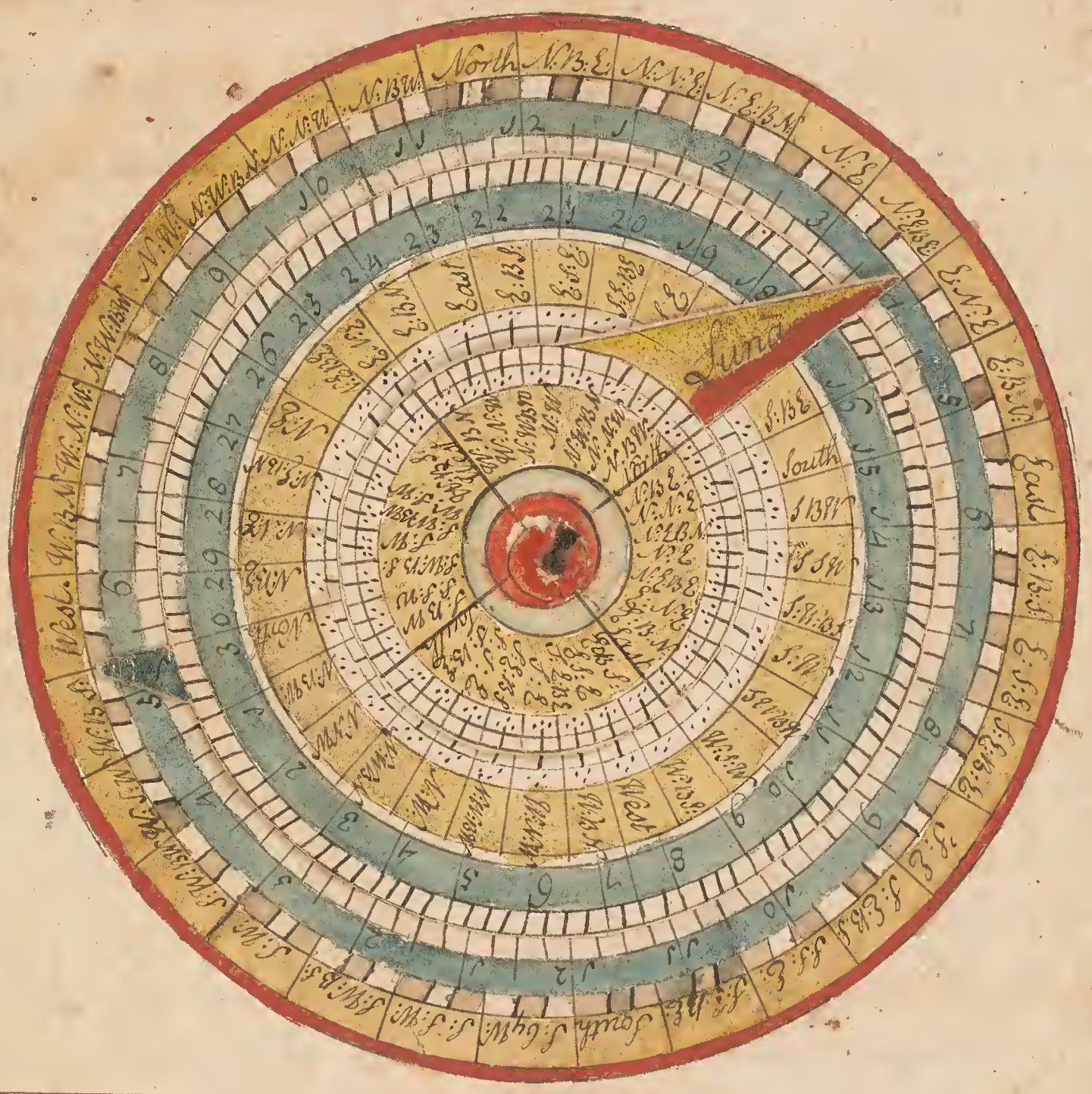
First, place a Board level on the Ground, then describe 5 or 6 Circles upon one common Center, and place a Pin or Wire in the Center directly perpendicular; this done, in the Forenoon, when the Sun shines, put a mark where the extremity of the Shadow of ye Gnomon touches one of these Circles, and observe again in the Afternoon of the same Day till the Shadow touch the same Circle that was marked in the Forenoon, and then make another mark; Bisect the Arch intercepted between them, and draw a Line from the Center through into the Bisection; then observe any Day thereafter untill the Shadow of the Gnomon fall directly upon that Line, for then the Sun is upon the Meridian in that place, and you may place your Dial accordingly. The reason for drawing several Circles is, that several of them may be marked lest the Sun be over clouded at any time in the Afternoon. N. B: the Figures 1, 2, 3, beside the Points shew the Places of the Circle the Sun touches

A Dial within



A Mariner's Compass

An Excellent Variation Compass.



Uses of the Variation Compass.

Problem 1. The Hour of the Day or Night & the Moons Age being given, to find on what point of the Compass the Moon is.

Place the middle Index of Sol to the Hour given, then bring the upper Index of Luna to the Day of the Moons Age in the middle circle of Sol, & the Index of Luna will shew the true Point of the Compass on the lower=most fixed Circle which the Moon will be on at the given Hour. Ex: The Moon being 16 Days old, on what Point of the Compass will she be at 8 of Clock at Night? Ans: E: S: E: half a point Southerly.

Prob: 2. The Moon's Age being given & the Point of the Com:=pass she is upon, to know what o'Clock it is.

Turn the Index of Luna to the point given, then bring the given Day of the Moon right under Luna's Index, & the Index of Sol will point to the Hour demanded. Ex: What o'Clock is it when the Moon, being 16 Days old, is on the S: E: point of the Compass? Ans: 10 o'Clock at Night.

Prob: 3. The Hour being given, and the point of the Compass the Moon is on, to know how many Days old she is.

Set the Index of Luna to the given point of the Compass, and the In:=dex of Sol to the given Hour, and where the Index of Luna cuts the Circle of Days you have the Day of the Moon's Age. Ex: The Moon being S: E: By S: at 8 o'Clock at Night, How many Days old is she? Ans: 13 Days old.

Prob: 4. The points of the Compass on which both Sun & Moon are, being given, to find the Moon's Age.

Set the Index of Sol & Luna to their respective points given, and where the Index of Luna cuts the Circle of Days you have the Day of the Mon's Age. Ex: The Moon being E: S: E: and the Sun at W: N: W, What is the Moon's Age? Ans: 15 Days old which is the Full.

Prob: 5. The Moon's Age being given, to find the Hour when she will be upon any point given.

Set the Index of Luna to the given point, & turn the Index of Sol about till the Day of the Moon is under ye Index of Luna, & ye Index of Sol will point to the Hour required. Ex: When ye Moon is 17 Days old, at what Hour will she be E: N: E: Ans: 6 o'Clock at Night.

Prob: 6. The point of the Compass on which the Moon is, at the time of high Water in any Port, River, or Creek, on the Day of her Change being given, to find the Ebbing & Flowing of the Tides, and Time of high Water or Full Sea in the said Port &c on any other Day of the Moons Age.

Bring the Index of Luna to the Point of the Compass the Moon is on, & it is Full Sea in the given Port, then bring the Day of the Moons Age directly under the Index of Luna, and the Index of Sol will point to the Hour when it is Full Sea in such Port &c. Ex: At what o' Clock will it be full Sea at Aberdeen & Stonehyve where a South By West Moon on the Change Day makes Full Sea, when the Moon is 8 Days old? Ans: 12 Minuts after 7 o' Clock at Night.

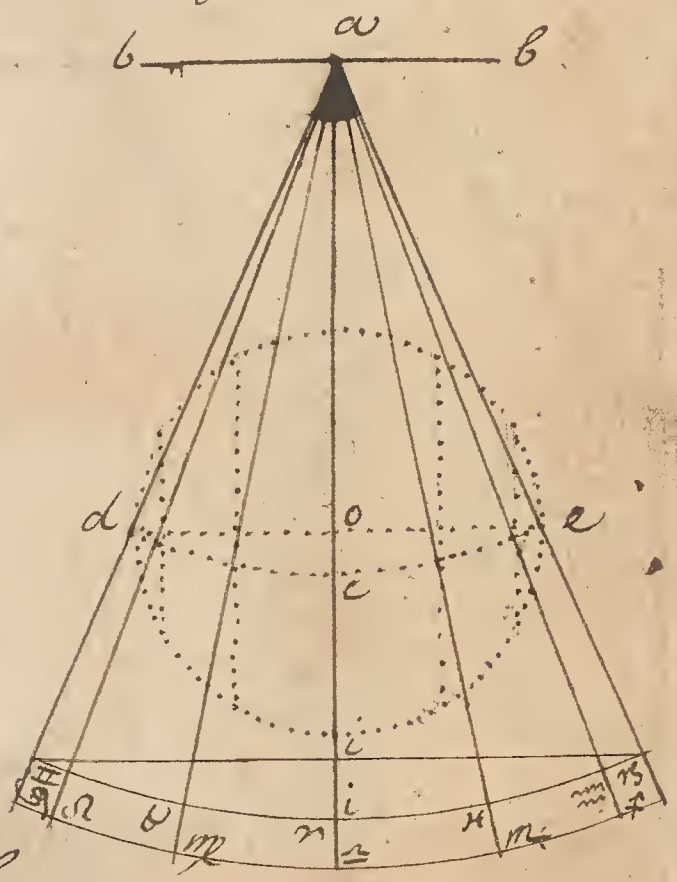
A Method for Investigating the apparent Place of a Comet.

Observe what two Stars are directly one on one Side, & the other on the other; which is done by holding up a Thread between the Eye & the two Stars, and extending it in such a manner, as that it shall seem to cross each Star: Then look out for two other Stars in a like situation, that the Comet may appear in a Line drawn from one to the other; which are found as before. Then extend a Thread on the Celestial Globe, from one of the two first Stars to the other; and another Thread from one of the last two Stars to the other: And the point of the Globe where the Threads cross, is the apparent place of the Comet, at the time the Observation was made.

Leo
Cancer
Gemini
Taurus
Aries
Pisces
Aquary
Capricorn
Sagittary
Scorpio
Libra
Virgo
West
East
June
July
August
September
October
November
December
January
February
March
April
May
Moon's Age
Southing
Rising
Setting
Lat. North
Lat. South
Long. East
Long. West

The Construction of the Trigon of Signes

First draw the Line a b, representing the Axis of the World, and a c perpendicular thereto, representing the Radius of the Equinoctial, and about the point a describe the Circular Arc d e e at pleasure. This being done, reckon 23½ deg. both ways from the point c upon the said Arc, for the Sun's greatest Declination, and draw the two Lines a d, a e, for the Summer and Winter Tropicks; likewise draw the Line d e, which will be bisected by the Radius of the Equinoctial in the point o, about which, as a Center, draw a Circle, whose Circumference passes thro' the Points d & e of Tropicks, and divide the Circumference thereof in 12 equal parts, beginning from the Point d. Then thro each point of the Division equally distant from d and e, draw occult Lines parallel to the Radius of the Equinoctial Circle. These Lines will intersect the Arc d c in Points thro which and the Center (a) Lines d a being drawn, these Lines will represent the beginings of the Signes of the Zodiack, at 30 deg: distance from each other.



But to divide the Signs into every 10th or 5th Degree, you must divide the Circumference of the Circle into 36 or 72 equal parts. After this, we denote the Characters of the Signs upon each Line, as appears by Figure. And when the Trigon is divided into every 10th or 5th Degree, we place the Letter of the Month to the first 10 Deg: of each Sign agreeing therewith.

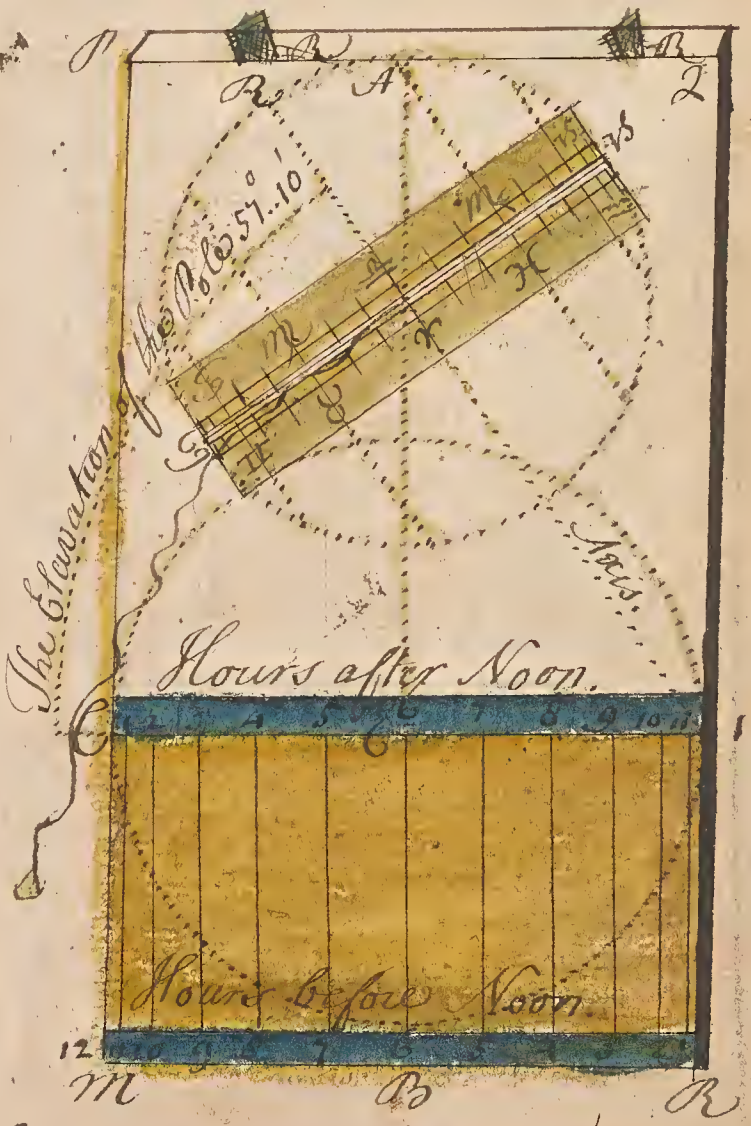
But the Trigon of Signs may be readier made by means of a Table of the Sun's Declination; for having drawn the two Lines a b and a c at right Angles, cay the Center (a)

Rad:

Protractor on the point A with its Limb towards the Point C; and keeping it fixed thus, count 23½ deg: on both sides the Radius A C, for the Tropicks of ☋ and ♑, 20°..12' for the beginning of the Signs ♌, ♊, ♐ and ♓, and 11°30' for ♉, ♍, ♏, and ♑. And in this manner we divide the Spaces for each Sign into 10th or 5th deg: by means of the Table of the Sun's Declination for every degree in the Ecliptic in the end of this Book page ... Note, The Equinoctial Points of ♈ and ♎ are placed at the end of the radius of the Equinoctial A C.

The Construction and Use of a particular right lined Dial.

This Dial, which is called particular, because it serves for one determinate Latitude, is made upon a very even plate of Brass, or other Metall, about the bigness of a playing Card, and is much the same as the Figure on page 17). The Construction thereof is thus: First, draw the two right lines A B, C D, crossing one another at right Angles in the point E, about which, as a Center, with the Radius E C describe the Circle C B D, and divide it into 24 equal parts, begining from the point D; then thro' each two Divisions equally distant from the Points C & D, draw 2 parallel right Lines, which will be the Hour Lines, whereof D R is that of 12, B E that of 6, and C M that of Mid-night. This being done, form the right-angled Parallelogram P M 2 R, & draw the occult Line D R, making an Angle with C D equal to the Elevation of the Pole viz: 51°..10', This Line shall represent the Radius of the Equinoctial, and by means thereof the Trigon of Signs must be formed, having D for its Vertex. In order for this, produce the Hour Line of the Sun's rising in the longest Day of Summer, which here is the Hour Line of 3; as likewise the Hour Line of 6, untill it meets the Radius of the Equinoctial Circle D R; then the point in the Radius of the



Equi:

Equinoctial cut by the Hour Line of 6, will be the Cen=
=ter of a Circle, whose Diameter shall be perpendicular to
the said Radius, and is terminated by the Intersection of the Hour Line of 4 there=
=with. This Circle being described, divide the Circumference
thereof into 12 Equal parts, in order to form the Trigon of Signs,
as is before explained as on Page 24. Note, The two Tro=
=picks will be at the Extremities of the said Diameter, each
making an Angle of 23°. 30' with the Radius of the Equi=
=noctial, the Vertex being the Point D. Now the next thing
to be done, must be to make a little slit along the Radius of
the Equinoctial, that so the little Slider or Cursor may
slide along it, having a little Hole drilled thro it for fasten=
=ing a Thread or Plummet with a Bead or Pin's head on
the Thread. And after this, we place two sights on the Ex=
=tremities of the Line P 2 as R R.

The Use of this Dial.

Slide the Cursor, and fix the Hole in which the Thread
is fastned over the Degree of the Sign the Sun is in, or the
Day of the Month; slip the Bead or Pin's head along the Thread,
untill it be upon the Hour Line of 12. This being done, hold up
your Instrument, lifting it higher or lower till the Sun
shines thro the Holes of the Sights R & R, and the Thread
freely plays upon the Plane thereof; then the Bead will
fall upon the Hour of the Day.

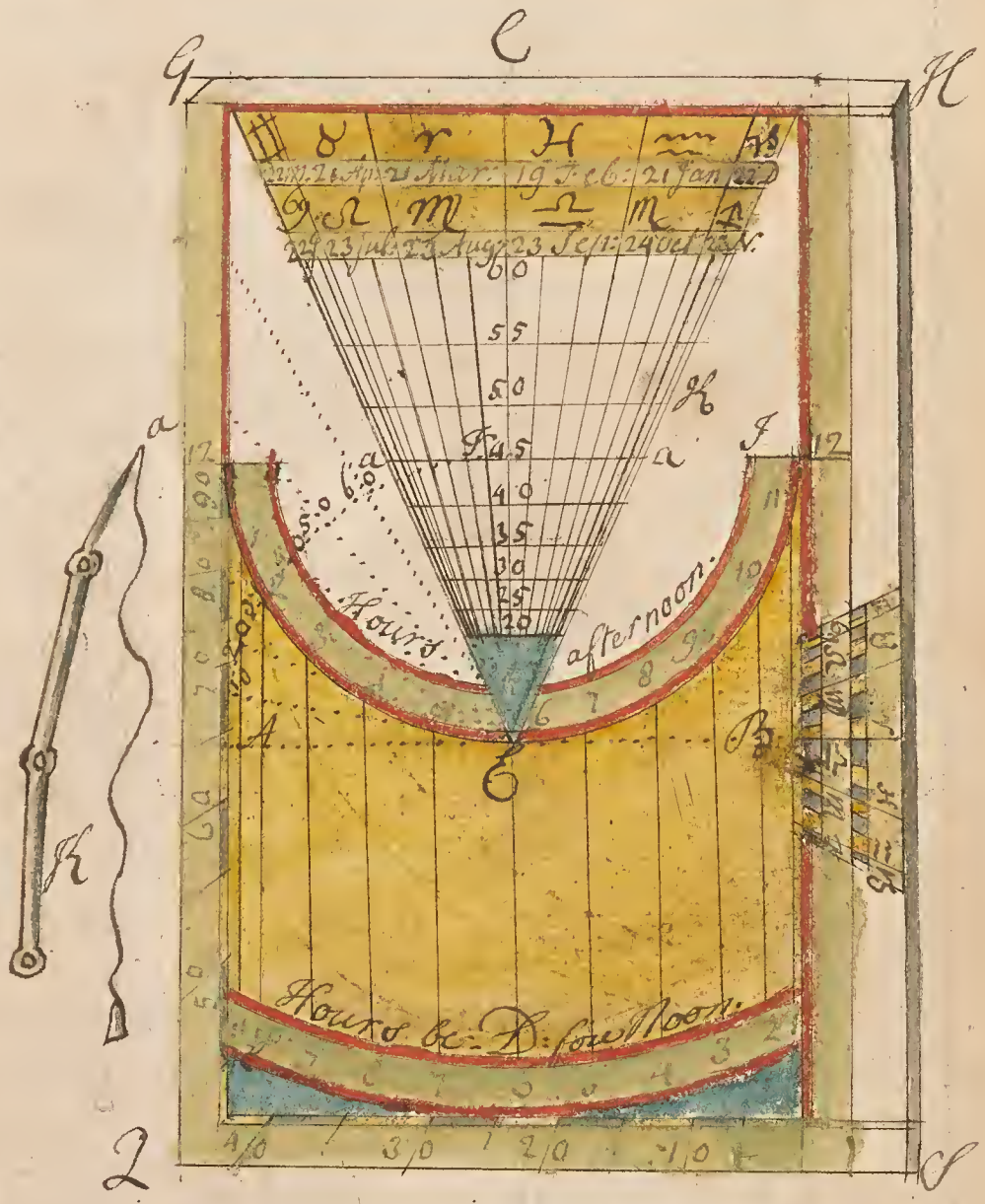
The Construction of a Universal right-lined Dial.

This right-lined Dial, which ~~for~~ for all Latitudes,
is made of a Circle at pleasure, upon a very even plate
of Brass or other solid Matter. The Construction of it is
thus: Draw the Lines A B, C D, cutting each other at right
Angles in the Point E, about which, as a Center, describe the
Quadrant A F, which divide into 90 deg: and with the point
E for the Vertex, make a Trigon of Signs according to the

Method

Method explained on Page 24th... Divide each Sign in to 3 parts, each being 10 Degrees and set the Letters of the Months to the places corresponding to them, by supposing that the Sun's entrance into every Sign is the 20th Day of the Month (N: S:) for example, his entrence into ♈ the 20th of March, his entrance into ♉ the 20th of April, &c. This may be without any sensible Error in so small an Instrument. Now draw dotted Lines from the Center E thro the Divisions of the Quadrant A F, to the Line A G, which will divide it into points, from which Prallels must be drawn to the Line A B, which shall be the different Latitudes or Elevati-

-ons of the Pole, which must be only marked between the two Tropicks, as you see in the fi-gure, wherein they are drawn to every 5th deg: On both the sides the Point B lay off upon the Line B H, the Divisions that the Radij of the Signs of the Trigon make on the Line a a, representing the Latitude of 45 deg: that so the Repre-sentation of another Zodiac may be made upon the Line B H.



Now the manner of draw-ing the Hour Lines upon this Dial is thus: Draw Lines thro every 15 degree of the Quadrant A F, parallel to E D, which is the Hour Line of 6; and these Parallels will be the Hour Lines from 6 in the Evening to 6 in the Morning, A L being the Hour Line of Midnight. And if the parallel spaces be laid off on the other side of the hour Line of 6, you will have the hour Lines from 6 in the Morning to 6 in the Evening. And for draw-ing the half hours, divide each 15th deg: of the Quadrant A F into half, and draw parallel Lines between the Hour Lines.

About the Point J, as a Center, draw an Arc of Quadrant,

which

Which divide into 90 deg: and laying a Ruler to the Center I, and on each Division mark the same Degrees upon the sides G2, and G S of the Instrument. Note, by means of these Divisions the sun's Altitude is found above the Horizon, as will be shewn by and by. R R are two Sights fixed on the side G H. And the Piece Ik is a small Arm or Index, made of three blades of brass, so joined to each other by headed Rivets, that they may have a Motion either to the right or left: at the sharp end of this Arm is made a very little hole, thro which goes a Thread and with a Plummet at the end thereof, and a little Bid or Pin's head thereon. This little Arm is fastned to the Instrument with a headed Rivet, that so it may have a Motion at the point K.

The Use of this Dial.

If the Hour of the Day be to be found by this Instrument, you must adjust the end a of the Index on the Intersection of the Line of the Latitude of the Place, and the Degree of the Sine the Sun is in, or the Day of the Month; then cast the Thread, and slide the bead to the same Degree of the Sign in the little Zodiac, drawn on the Hour Line of 12 B I. This being done, hold the Instrument up untill the Sun shines thro' the Sights R R, and the Thread freely playing upon the Plane of the Instrument, the Bead will fall upon the Hour of the Day.

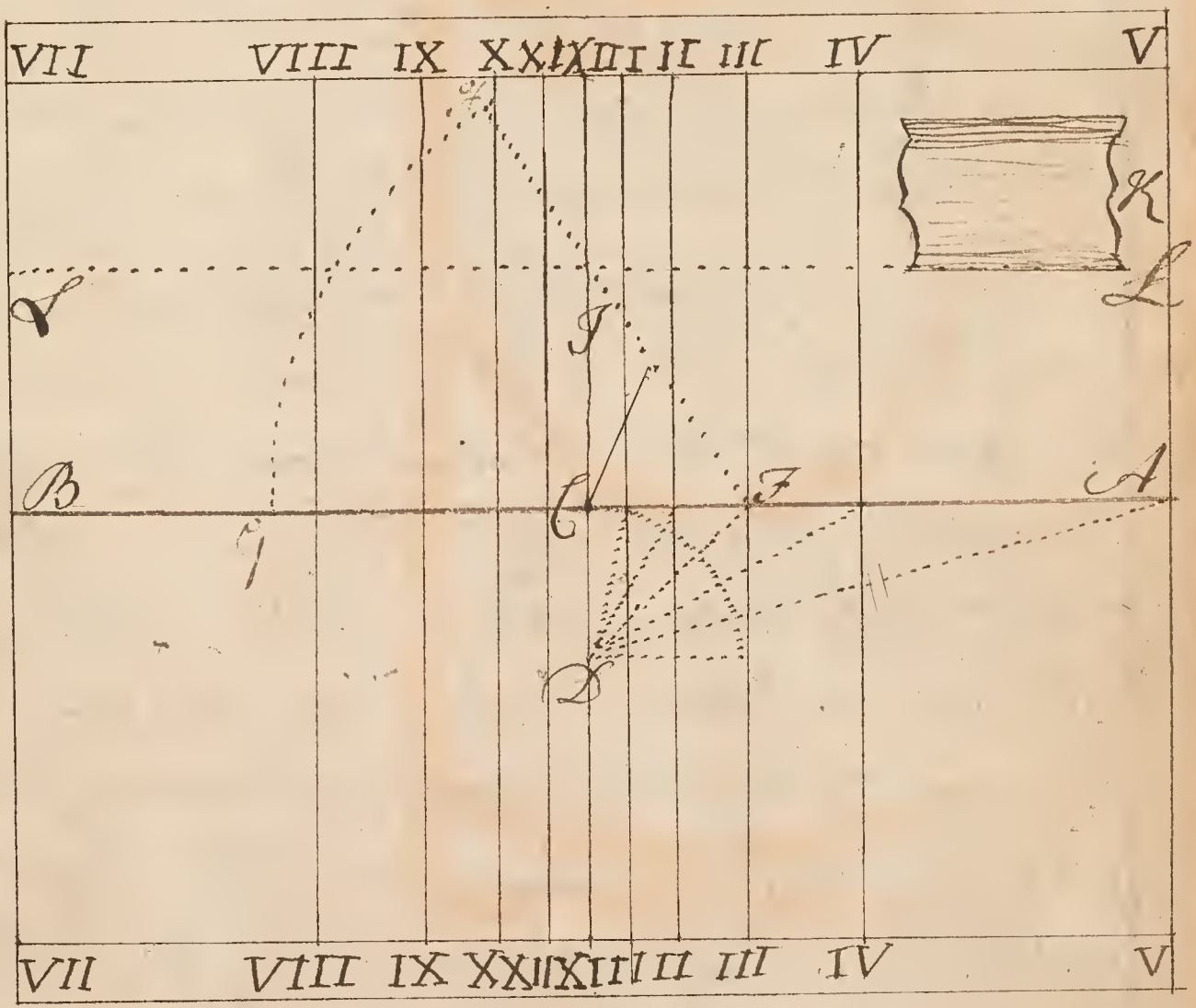
If the time of the Sun's rising & setting in all the Signs of the Zodiac for the Latitudes denoted upon the Instrument be required, fix the end a of the Index on the Intersection of the Line of the Latitude of the Place, and the Degree of the Sign the Sun is in; then the Thread freely falling parallel to the Hour-Lines, will shew the Hour of the rising & setting of the Sun. For Example, the end of the Index being fixed on the Intersection of the Sign of 69, and the Line of the Latitude 57°.16' the Thread will fall along the Hour Line of 3 in the Morning, or 9 in the Evening: And this Shews, that about the 20th of June, N: S, the Sun rises at Aberdeen, at 3 in the Morning, & sets at 9 in the Evening, & so of others.

The Elevation of the Pole is found thus: Place the end of the of the Index on the point I, & raise or lower the Instrument untill the Sun's Rays pass thro' the Holes of Sights; then the Thread freely plaing, will shew the Suns Altitude upon the Degrees on the side 2 S or 2 G.

The Construction of a Polar Dial.

An Upper Polar Dial, is one that inclines upwards, but does not decline: for it is parallel to the Axis of the World, and the Hour Circle of 6, which cuts the Meridian at right Angles. And for this reason the Hour of 6 in the Morning & Evening can never be shewn by this Dial; for the Shadow of the ~~Dial~~ Style being then parallel to the plain of the Dial, cannot be cast upon it. This Dial likewise hath no Center, and the Hour Lines are all parallel between themselves, and to the Axis of the World. The Plane therefore being parallel to the Horizon of a right Sphere, passes thro' the Poles of the World, from whence comes the Name of a Polar Dial.

The Manner of drawing this Dial is thus: First draw the Line A B representing the Equinoctial, and at right Angles thereto, for the Meridian or Hour Line of 12. Then assume the length of the Style at pleasure, according to the bigness of the Plane the Dial is to be drawn upon; Let this be C D, about the Extremity of which D describe a Quadrant, which divide into six equal parts, for only describe an Arc of 6 Degrees, which divide into four parts, of 15 Degrees each, for the four first Hours after Noon, and then add an Arc of 15 Deg: for the Hour of 5.) This being done, draw dotted Lines from the D, thro' the Divisions of the Circumference of the said Arc,



Arc, to the Line A B; and then if Lines are drawn thro' the Points wherein the dotted Lines cut the Line A B, parallel to the Meridian, these Lines will be the Hour Lines on one Side of the Meridian: And if there be as many Par=rallels drawn on the other Side of the Meridian, at the same Distances therefrom as the respective Parallels Hour Lines are on the other Side, these will be the Hour Lines on the other Side of the Meridian. The Style of this Dial must be equal in length to C F, the Distance from the Hour Line of 12 to the Hour Line of 3, and may be made in form of a Right angled Parallelogram, as is that marked beside the Letter K in the Figure of the Dial. This Style is set upon the Hour Line of 12, which for this reason is called the Substylar Line. ——— If a single Rod only be used for a Style, as that which is in the Point C of the Meridian, then the Hour will be shewn upon this Dial by the Shadow of the Extremity of the Style, whereas when a Parallelogram is used, we have the Hour shewn by the Shadow of one of it's Sides, that is, by a right Line. ——— An upper Polar ~~Dial~~ may shew the Hour from seven in the Morning to five in the Afternoon; and an under Polar one is useless, un=less in the Summer, wherein the Hour is shewn, from Sun rising to five in the Morning & from seven in the Evening to Sun setting; and these may be drawn as these on the upper Polar Dial, for the Distances of the Hour Lines of 4 and five in the Afternoon from the Sub=style, on the upper Polar Dials, are equal to the Hour Distance of 4 & 5 in the Morning from the Substyle on the under Polar Dial and so of any other of the Hours, Understand the same for the Hours of 7 & 8 in y^e^ Afternoon; and therefore there is no need for drawing the Lines of this Dial. Note, The Hour distances of this Dial on

Depend upon the Breadth of the Style, or the distance of the point D from the Equinoctial Line.

To set up this Dial at Aberdeen, the Plane thereof must make an Angle of 57°. 12′ with the Horizon, the upper one facing the Sky directly South, that so the Axis thereof may be parallel to the Axis of the World, and the opposite Dial to this, viz. the under Polar Dial one faces downwards, the Morning Hours being towards the West, and the Afternoon ones towards the East, on both the upper & under ones.

Now if the Horizontal Line is to be drawn upon this Dial, describe the Arc G H, about the point F, the Extremity of the Style, equal to the Elevation of the Pole, viz. 57° 12′, and draw the right Line F H, cutting the Meridian in the Point I, thro which draw the Horizontall Line L L at right Angles. Now by means of this Line, we may know whether the Dial be well placed, and have its convenient Inclination; for if the Dial be inclined rightly, a Plane laid along the Horizontal Line, and supported by the Edge of the Style, will be levell or Parallel to the Horizon.

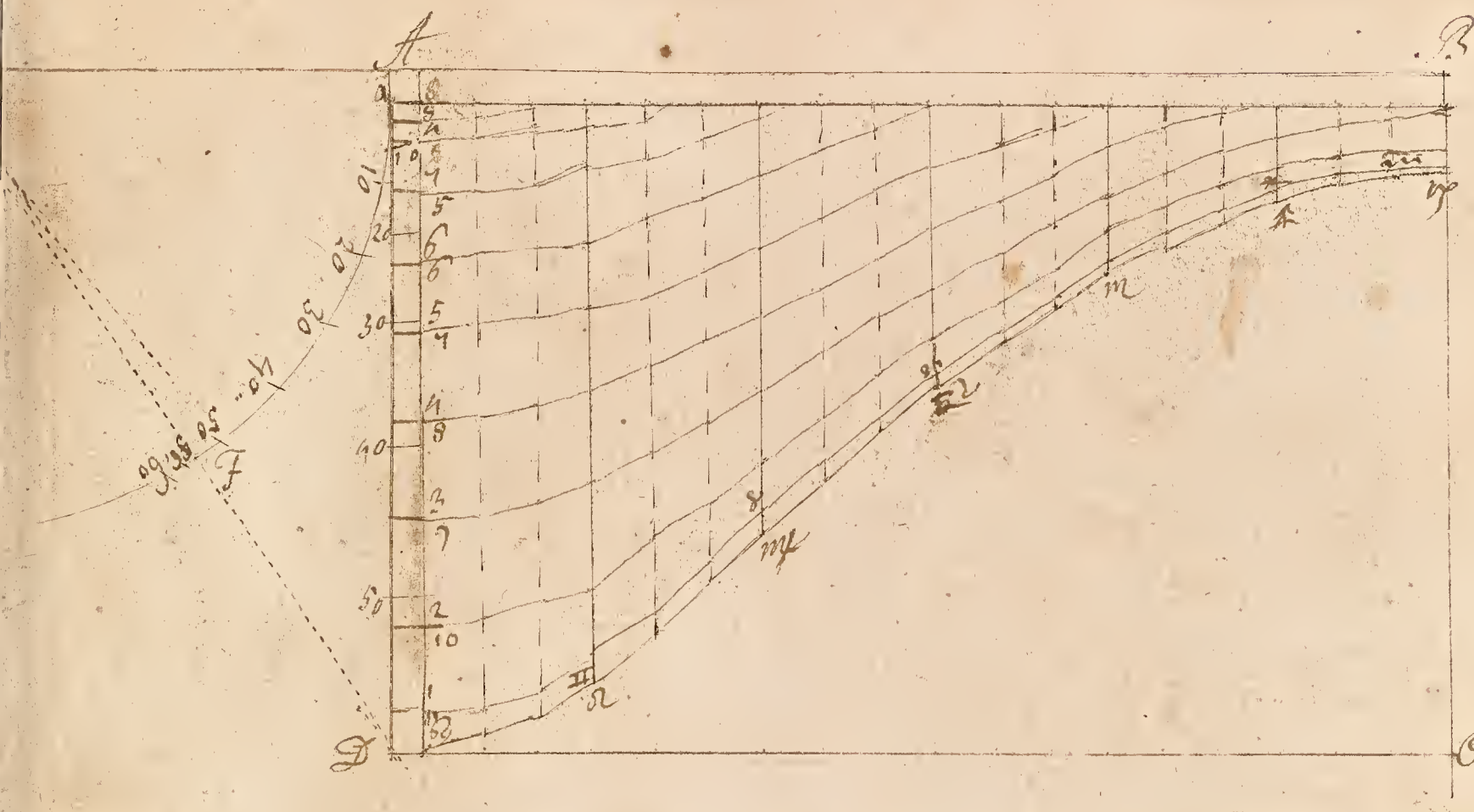
A Polar Dial in a right Sphere is parallel to the Horizon, & in a parallel Sphere it is vertical or upright.

A Table of the Sun's Altitudes for every Hour of the Day at his Entrance into every 10th Degree of the Signs for the Latitude of 57° 12'.

Hours	12	11 1	10 2	9 3	8 4	7 5	6 6	5 7	4 8	3 9
Signs	o .. '	o .. '	o .. '	o .. '	o .. '	o .. '	o .. '	o .. '	o .. '	o .. '
20 ♈	56 .. 18	54 .. 35	49 .. 57	43 .. 21	35 .. 42	27 .. 38	19 .. 35	11 .. 56	4 .. 59	1 .. 53
20 10	55 .. 55	54 .. 13	49 .. 36	43 .. 02	35 .. 24	27 .. 19	19 .. 16	11 .. 36	4 .. 38	1 .. 32
10 20	54 .. 48	53 .. 08	48 .. 35	42 .. 04	34 .. 29	26 .. 25	18 .. 21	10 .. 40	3 .. 39	0 .. 32
☊ ♉	53 .. 00	51 .. 23	46 .. 56	40 .. 32	33 .. 00	24 .. 57	16 .. 52	9 .. 08	2 .. 04	
20 10	50 .. 35	49 .. 01	44 .. 42	38 .. 26	30 .. 59	23 .. 58	14 .. 53	7 .. 05	1 .. 38	
10 20	47 .. 39	46 .. 09	41 .. 59	35 .. 51	28 .. 30	20 .. 33	12 .. 27	4 .. 35	0 .. 52	
☌ ♊	44 .. 18	42 .. 53	38 .. 51	32 .. 53	25 .. 40	17 .. 46	9 .. 39	1 .. 44		
20 10	40 .. 38	39 .. 16	35 .. 25	29 .. 37	22 .. 31	14 .. 41	6 .. 35	0 .. 34		
10 20	36 .. 46	35 .. 27	31 .. 45	26 .. 07	19 .. 10	11 .. 23	3 .. 20	1 .. 20		
♈ ♋	32 .. 48	31 .. 33	27 .. 58	22 .. 31	15 .. 43	8 .. 03	00 .. 00			
20 10	28 .. 50	27 .. 38	24 .. 12	18 .. 34	12 .. 15	4 .. 41	0 .. 42	after 6		
10 20	24 .. 58	23 .. 49	20 .. 30	15 .. 22	8 .. 51	1 .. 24				
♎ ♌	21 .. 18	20 .. 11	16 .. 59	12 .. 00	5 .. 37	0 .. 10	after 5			
20 10	17 .. 57	16 .. 53	13 .. 40	8 .. 55	2 .. 40	0 .. 56	½ H after or before 5 or 7			
10 20	15 .. 01	13 .. 58	10 .. 57	6 .. 12	0 .. 04					
♐ ♍	12 .. 36	11 .. 35	8 .. 38	3 .. 58	1 .. 06	h after 6	hour after 5 or before 7			
20 10	10 .. 48	9 .. 48	6 .. 54	2 .. 19	0 .. 56	½ q: before or after 6				
10 20	9 .. 41	8 .. 41	5 .. 49	1 .. 15						
♑ ♎	9 .. 18	8 .. 19	5 .. 27	0 .. 56						

Construction and Use of the Vertical Cylinder.

Describe the Right angled Parallelogram A B C D upon a Brass plate or sheet of Paper, whose Breadth A B or C D let be nearly equal to the Circumference of the Cylinder it is to be wrapped round, and prolong the Line A B, upon which assume A E for the Length of the Style, which shall determine the Length of the Cylinder A D; ~~but if this Length were given, & the Length of the Style required, describe an Arc about E with the Radius E A equal to the Complement of~~ Then about the Point E, as Center, with the Radius E A, make a Circular Arc equal to the Sun's Meridian Altitude at his Entrance into ♑, and draw the occult Line E G, determining



determining the Length or height of the Cylinder AD.
but if this length was given, and the length of the Style
required, describe an Arc about the point D, equal to the
Compliment of the Sun's greatest Meridian Altitude, which
if the greatest Meridian Altitude be 56° 18' will be 33° 42',
and draw the occult Line D E, which shall determine ye length
of the Style E A, proportioned to the Length of the Cylinder.

This being done, divide the Arc into Degrees & Minuts,
and draw occult Lines thro' each of those points of Division
from the Center E to the Line A D, that so this Line may be
made a Scale of Tangents. Then divide the Sides A B, D C into
6 equal parts, and join the points of Division by 5 parallel
Right Lines, which will represent the beginnings of ye 12 Signs,
then trisect each of these parallel spaces for the 10th & 20th Degree
of each sign; or the corresponding days of the Months. Then prick
down the hour points upon each parallel according to the fore-
going Table of the Sun's Altitude, and join the several points
so found with curved Lines, as you see in the Diagram.

The Stile being moveable on the Top, must be placed at right
Angles of the Degree of the Sun or Day of the Month, that the
shadow may fall upon the parallel of the Day, and the Extremity
thereof will shew the Hour. The Case will be the same if
this Dial be used as a Parallelogram, as well as a Cylinder.

N.B. The Diagram will answer the purpose, tho' it wrong
drawn the Tangent be drawn from the point A to D, and the Circle
from b to a.

Of the Sphere.

Definitions. A Sphere, or Globe, is a round solid Body made by the motion of a Semicircle about its own Diameter, till the Motion end where it began. In the midst of the Sphere is a point, called the Center, from whence all Lines drawn to the Superfice are of equal length.

The Axis of the Sphere is the Diameter of the Semicircle, which produceth it.

The Poles of the Sphere are the extremities of its Axis.

There are two sorts of Spheres, vizt, the Celestial & Terrestrial. The Celestial Sphere is an Artificial representation of the Starry Heavens, shewing in a due proportion every particular Constellation. The Terrestrial Sphere hath placed upon it every particular Region or Country, on the Surface of the Earth, and Island in the Sea, together with the Water.

On these Artificial Globes are marked such Circles, as represent the Imaginary ones on the natural Globe, with relation to which are calculated the places and apparent Diurnal & Annual Motion of the Heavenly Bodies, and other Phænomena accounted for that depend upon those Motions.

Of the Circles of the Sphere.

The Circles of the Sphere are of two Sorts, vizt, Great Circles, & Lesser Circles. A Great Circle divides the Sphere into two equal parts. The Lesser divides into unequal parts.

The Great Circles.		The Lesser Circles.
1. The Meridian.	5. The Equinoctial Colure	1. The Artick Circle.
2. The Horizon.	6. The Solstitial Colure	2. The Antartick Circle
3. The Equinoctial.	7. The Vertical Circles	3. The Tropick of Cancer.
4. The Ecliptick.	8. The Hour Circles.	4. The Tropick of Capricorn

There are also Parallels of Altitude & Parallels of Declination, & Parallels of Latitude, wch are all Lesser Circles.

Astronomers

Astronomers make other divisions of the Circles of the Sphere, as some of them they reckon Parellel Circles, some right, some Oblique, some mutable, some immutable; of which,

1. The two Polar Circles, and the two Tropicks, are called Parellel Circles in respect of the Equinoctial, & lies in the very middle betwixt ym.

2. The two Colures, the Horizon, and the Meridian, are called right Circles, because they cut the Sphere at right Angles.

3. The Eclyptick is called an Oblique Circle, because it cutteth the Equinoctial or Equator at Oblique Angles, & because of its obliquity with the Horizon. Also, because in an Oblique Sphere the Horizon cuts the Equator at Oblique Angles, the Horizon is therefor called an oblique Circle.

4. The Equinoctial and Eclyptick are said both to be immutable Circles, because there is but one Equinoctial & one Eclyptick.

5. The Horizon & Meridian are said to be mutable Circles, because wherever a Man travails upon the Surface of the Earth he carries his Horizon always along with him; for he discovers some part of the Heavens, which he could not see before because of the roundnes of the Sea & Land: And the Meridian is a moveable Circle, for it changes its Place as often as any one travails never so little East or West from the place where he sets out; so that there are as many Meridians as you can conceive points in the Equator or Equinoctial.

6. The Latitude of a Place is reckoned either Northward or Southward upon the Meridian, according as the place is situated from the Equinoctial, & is equal to the Poles Elevation above the Horizon.

7. The Amplitude of the Sun is reckoned upon the Horizon from the East and West points thereof.

8. The Vertical or Azimuth Circle, wherever it falls, is always perpendicular to the Horizon. Upon the Azimuth Circle is reckoned the Altitude of the Sun, or Star, above the Horizon: And these Circles that pass through the Point of altitude are called Almicanters, or Parellels of Altitude.

A more particular Description of the Circles of the Sphere.

1. The **Meridian** is a great Circle of the Sphere passing thro' the **Zenith** & **Nadir** and Poles of the World, which Circle when the Sun comes to every Day with the Center of his Body above the Horizon, it's then Noon or mid-Day, and when he is under the Horizon and comes to the same Circle again it's then Mid-Night. It's called the

Meridian

Meridian, because it divides the Day exactly into two equal parts, it being as far from the Horizon, or place of Suns rising, to Noon, as it is from Mid-Day to the place of his setting.

Note, that all those places, which lie directly North & South from one another, have the same Meridian: But if places be distant never so little East & West from one another, they have different Meridians; and this difference, or distance of Meridians, is called the difference of Longitude.

This Circle divides the East part of the World from the West, and is ye very middle of the Artificial Days & Nights from which the Hours are reckoned. It divides the Equinoctial, & it's Parellels, into two equal parts; and amongst the Meridians, Geographers have fixed upon one, wch they call the first Meridian, from which they reckon ye distance of all other Meridians.

2. The Horizon is a Circle described by ye Eye, when you stand upon the Top of a Mountain, or when at Sea, or on a plain, you look round about as far as you can see; for then it forms itself, and seems to us as if ye Sea and Land reached the Heavens; so that we see our selves inclosed wth it and in the Center thereof: & this is called the sensible Horizon.

A great Circle parellel to it is called the rational Horizon, wch divides the Heavens & the Earth into two equal parts; so that one half of the Heavens is always visible above this Circle & the other half that is below it is invisible. The Poles of the Horizon are two points diametrically opposite, called ye Zenith & Nadir. The point directly above our Head is called the Zenith, & the point under our Feet, opposite to ye Zenith, is called the Nadir.

The Horizon is of use for finding the Poles Elevation, or ye Altitude of the Sun & stars, & to shew us the Stars y^t rise & set, & it informs us what Stars appear to us.

Note, How much the pole of the World is elevated above the Horizon, so much is the Zenith distant from the Equinoctial.

3. The Equator is a great Circle of the Sphere, commonly called the Equinoctial Line, dividing the same directly in the middle between the two Poles into two equal parts, called the Northern & Southern Hemispheres. From it the Latitude of places is reckoned either North or South, as also the Declination of the Sun & Stars.

This Circle is called the Equator, because when the Sun comes to it, which happeneth twice every Year; vizt 21st Day of March, when he enters into Aries, and the 23^d Day of September at his entrance into Libra, the Days & Nights are of equal length throughout the World: For the Horizon & Equator are two great Circles, which cut one another into two equal parts, from whence it follows, that the Sun, which on that

Day

Day seems to describe this Circle) takes as much time to describe that part wch is above ye Horizon, as he doth to describe ye other wch is below. So that this Circle is the Measure of the Suns apparent Diurnal motion; Hence 15 Degrees of the Equator answers to an Hour of Time, and 1° to 4 Minuts. Upon this Circle the Degrees of Longitude are counted from the first Meridian quite round the Terraqueous Globe, begining at 0 Degrees, and reckoning Eastward until the Accompt end in 360°. It shews also the right Ascension of the Sun and fixed Stars.

4. The Ecliptick is a great Circle of the Sphere, cutting the same into two equal parts, crossing the Equator at Oblique Angles of 23° 30' in the first points of Aries & Libra. It is the way of the suns apparent Annual motion.

This Circle is divided into 12 equal parts, called Signs, each containing 30°, & herein is reckoned the Longitude of the Sun from the nearest Equinoctial points, Aries & Libra. This Circle is called the way of the Sun; for he never swerveth from it, and by it is known what Sign and Degree the Sun is in at any Time of the Yeer; for the Sun describes this Circle in a yeer, or the space of 365 Days, and by consequence he goes through a Degree almost in a Day. Moreover, the Ecliptick line shews how & when the Eclypses happen.

Here follows ye Names & Characters of the 12 Signs. 1. Aries ♈, 2. Taurus ♉, 3. Gemini ♊, 4 Cancer ♋, 5 Leo ♌, 6 Virgo ♍, 7 Libra ♎, 8 Scorpion ♏, 9 Sagittarius ♐, 10 Capricorn ♑, 11 Aquarius ♒, 12 Pisces ♓.

5. The Colures are two great Circles of the Sphere, intersecting one another in the Poles of the World at right Angles; one of which is called the Equinoctial Colure, & the other is called the Solstitial Colure. The Equinoctial Colure cuts the Ecliptick in the beginning of Aries & Libra, the two points on which the Sun makes the Days & Nights of equal length throughout the whole World, & by consequence it divides the Ecliptick into 2 equal parts, ye Septentrional & Meridional, thereby shewing that, when the Sun is in the 6 Northern Signs, then the Day is longer than ye Night to all those that live in North Latitude; & on the contrary, when he is in the 6 Southern Signs, he makes the Night longer than the Day. The Solstitial Colure cuts the Ecliptick in the beginning of Cancer & Capricorn, which are the two solstitial points; for when the Sun is in any

of these points, which is about the of June and the of Dec^r, he as at the greatest Declination either North or South, & then his Dec=clination begins to decrease. Upon this Colure is reckoned y^e Suns decli:=nation, it being as a general Meridian, & these 4 Points of cutting are cal:=led the 4 Cardinal Points, wch shew the beginning of the 4 Seasons of y^e Year: for the Spring begins at the Sun's entrance into Aries upon the 21st Day of March, & continues till the Sun enter into Cancer. And at his entrance into Cancer, wch is upon y^e 22^d of June the Summer begins, & continues till the Sun enter into Libra, when the Harvest Quarter begins, & ends at his entrance into Capricorn, which is about the 22^d of December; & the Winter Quar:=ter begins, & ends at his entrance into Aries.

6. Vertical Circles, or Azimuths, are great Circles of the Sphere, passing thro' the Zenith & Nadir, cutting the Horizon at right Angles, of wch you may imagine as many as you please. Upon the Azimuth is counted the hight of the Sun or Stars; for the Altitude of any of the Heavenly Bodies is an Arch of an Azimuth Circle compre:=hended between the Horizon & the Center of the Sun or Star. These Circles serve also to show upon y^e Point of the compass the Sun & Stars are at an:=y time being visible above our Horizon; & they likewise shew how two places beer one from another. The Azimuths take their beginning generally from that Point of the Horizon at which the Sun rises & sets, from which they are reckoned either Northward or Southward: For if the Suns Azimuth from the South be known, by subtracting the same out of 180° ye Remainder is the Azimuth from the North.

7. The Hour Circles are great Circles of the Sphere, passing thro' the Poles of the World & every 15° of the Equator, cutting the same at Right Angles.

12. The Polar Circles, called the Artick & Antartick Circles, are two lesser Circles of the Sphere, parellel to the Equator; de:=scribed by one Revolution of the Poles of the Ecliptick about the Globe; for the poles of the Ecliptick are two points in the Solstitial Colure, each as far distant from the agreeing Pole of the World, as the Ecliptick declines from the Equator, being 23° 30' equal to the Sun's greatest Declination. The Circle described by the North pole of the Ecliptick is called the Artick Pole or Circle, & the other described by the South Pole of the Ecliptick is the Antartick Pole or Circle.

3.4. The Tropicks are two lesser Circles of the Sphere, parallel to the Equator, & 23°30' distant therefrom, The one called the Tropick of Cancer, & the other the Tropick of Capricorn. The Tropick of Cancer is described by the Sun, when he enters into Cancer, being then at his greatest declination North; for the Sun never declines beyond that Circle, & then the Days are at their greatest length in all places in North Latitude, & at the shortest to those in South Latitude. The like you are to understand of the Tropick of Capricorn; he is then at his greatest Declination South, & then the Days are at the greatest length to all places in South Latitude, and at the shortest to those in North Latitude.

These two Circles, together with the Polars, divide the Earth into five Zones. That which lies between the two Tropicks, being exposed to the direct Rays of the Sun, & consequently to the greatest Heat, is called the Torrid Zone. The two Zones within the Polar Circles, because the Streaks of the Suns Rays are very Oblique, & by consequence has less Heat, are called Frigid Zones. And the two Zones lying between the Tropicks & the Polar Circles are called Temperate Zones, because they are neither too hot nor too cold.

The Almicanters, or Parellels of Altitude, are little circles parellel to the Horizon & sheweth upon some one or other of ye Azimuths the Altitude of the Sun, Moon or Stars above the Horizon at any time you can observe them. These Circles grow still lesser & lesser towards the Zenith, and you may observe as many of them as there are parts & Points in the Azimuth between ye Horizon & your Zenith.

Climates are little Zones, comprehended between two Parellels of Latitude, so taken, as the longest Day of the greater Latitude is an half Hour longer than the longest Day of the lesser Latitude. And to know how many Climes, or Climates there are between the Equator & either of the Polar Circles; the longest Day at the Equator is 12 Hours & at either Polar Circle 24 Hours, the difference between those Days is 12 Hours which makes 24 half Hours, therefor ye Number of Climates between ye Equator & each Polar Circle are 24, & the whole Number between ye

Two Polar Circles are 48: And to find how many there are within each of the Polar Circles; the longest Day at either Pole is 6 Months & allowing the Days to increase by intire Months from the Polar Circles to the Poles, there will be 6 Climates from either of the Polar Circles to the nearest Pole, which in both make 12, & being added to the former 48 makes the whole Number of Climates to be sixty

Of the various Position of the Sphere.

The Sphere in respect of the Horizon is to some People Right, to others Parellel and to others Oblique.

1. A Right Sphere is, when the Equator is perpendicular to the Horizon. This Position of this Sphere have they that live at the Equator; for the poles of their Horizon, or that which is called the Zenith & Nadir, are two points of the Equator, & it hath the two Poles of the World in the Horizon: Their Days and Nights are of equal length throughout the whole Year; for the Parellels of Declination, as well as the Equator, are bisected by the Horizon, & consequently the Sun will be as long above as below the Horizon. When the Sun enters into the Equinoctial Points, Aries & Libra, he then comes to the Meridian in their Zenith, & their Shadow at Noon is directly under their Feet; when the Sun hath North Declination they cast their Mid-Day Shadow South, and when he hath South Declination they cast their Mid-Day Shadow North in ye Morning they cast their Shadow West, & in the Evening they cast it East.

2. A Parallel Sphere is, when one of the Poles of the World is the Zenith & the other the Nadir, and the Equator coincides with the Horizon. This Position of the Sphere have they that live at the Poles; & seing the Equator is in the Horizon, all its parallels are parallel to the Horizon; the Inhabitants, if any live there, have half a Year of continual Day, viz, all the Time the Sun is in the 6 Northern Signs, he being still above the Horizon; & consequently, when he is in the 6 Southern Signs they have continual Night, the Sun being all that Time under their Horizon: Their Shadows go round them every 24 Hours, by which means a Style being erected Perpendicular to the Plane of the Horizon, & a Circle described about it as a Center, & divided into 24 equal Parts, shall be a Dial to shew the true Hour of the Day, making the North Point the 12 Hour.

3. An Oblique Sphere is, when the Equator and its Par-

Parellels cut the Horizon at Oblique Angles, This position of the Sphere have they that live betwixt the Equator & the Poles. The Pole nearest the Zenith is always elevated above the Horizon equal to the Latitude of the Place, & the other Pole is as much depressed below it; & the distance between the Poles of the World & those of the Horizon is equal to the Complement of Latitude. In this Sphere the Days & Nights are unequal in length, except when the Sun is in the Equator which is twice a Year; for the Equator is divided equally by the Horizon, - but its parallels unequally, & the Sun and Stars perform their diurnal motion in Circles oblique to the Horizon. And seing when the Sun is in the Equator the Days & Nights are of equal length, 'tis evident that those who live on the North side of the Equator, when the Sun hath North declination, have their Days longer than the Night, & the Day still increases in length as he approches nearer ye Zenith, and when he is in the Solstitial point, that is, at his entrance into Cancer, the Day is at the greatest length: & the like is to be under=stood of those, who live on the South side of the Equator, when the Sun hath South declination. And it is to be observed, that the greater the Latitude is, the longer will their longest Day be; So that at the Polar Circle in Lat: 66° 30' there longest Day is 24 Hours.

Some other Astronomical Definitions.

1. The Latitude of the place you are in, either North or South, is ye hight of either Pole above ye Horizon, or ye distance betwen ye Zenith & ye Equator, rechoning 60 Miles to a Degree.

2. The Latitude of a Star is an Arch of a great Circle contain'd between the Eclyptick & the Center of the Star, the Circle whereon it is reckoned, cutting the Elyptick Line at right Angles: & the Latitude is reckoned either North or South according to the Situation of the Star; the great Circle, whereon it is counted, passing thro' the poles of ye Elyptick, & are 23° 30' distant from the Poles of ye World, equal to the Suns greatest declination.

3. The Longitude of a Place is an Arch of the Equator intercepted betwen the first Meridian, i.e. the Meridian where the Longitude is assigned to begin, & ye Meridian of ye given Place, always reckoned Easterly.

4. The Longitude of a Star is an Arch of the Eclyptick, which is contained betwen ye Star's place in ye Eclyptick & the 1° of Aries according to the Succession of Signs.

5. The Altitude of ye Sun, Moon, or Star, is an Arch of an Azimuth comprehended betwen ye Horizon & ye Center of ye Sun, Moon, or Star.

6.

6. Ascension is the rising of the Sun, Moon, or Star, above the Horizon; & Descension the setting.

7. Right Ascension of the Sun, or Stars, is ye Point, or Degree & Minute, of the Equator, rechoned from ye beginning of Aries, yt comes to ye Meridian wt the Sun, Moon, or Star, on any part of the Ecliptick.

8. Oblique Ascension is an Arch of the Equator intercepted between the beginning of Aries & that Point yt riseth or comes to the Horizon with the center of the Sun, Moon, or Star.

9. Oblique Descension is the setting thereof.

10. Ascensional Difference is the Difference between the right & oblique Ascension & Descension.

11. The Amplitude of the Sun, Moon, or Stars, is ye distance of their rising & setting from yt true East & West points of the Horizon.

12. The Declination of the Sun is his distance from ye Equator, either Northward or Southward, according to the Pole he inclineth to.

To project the Sphere.

The Projection of the Spere is either Orthagraphical or Stereographical.

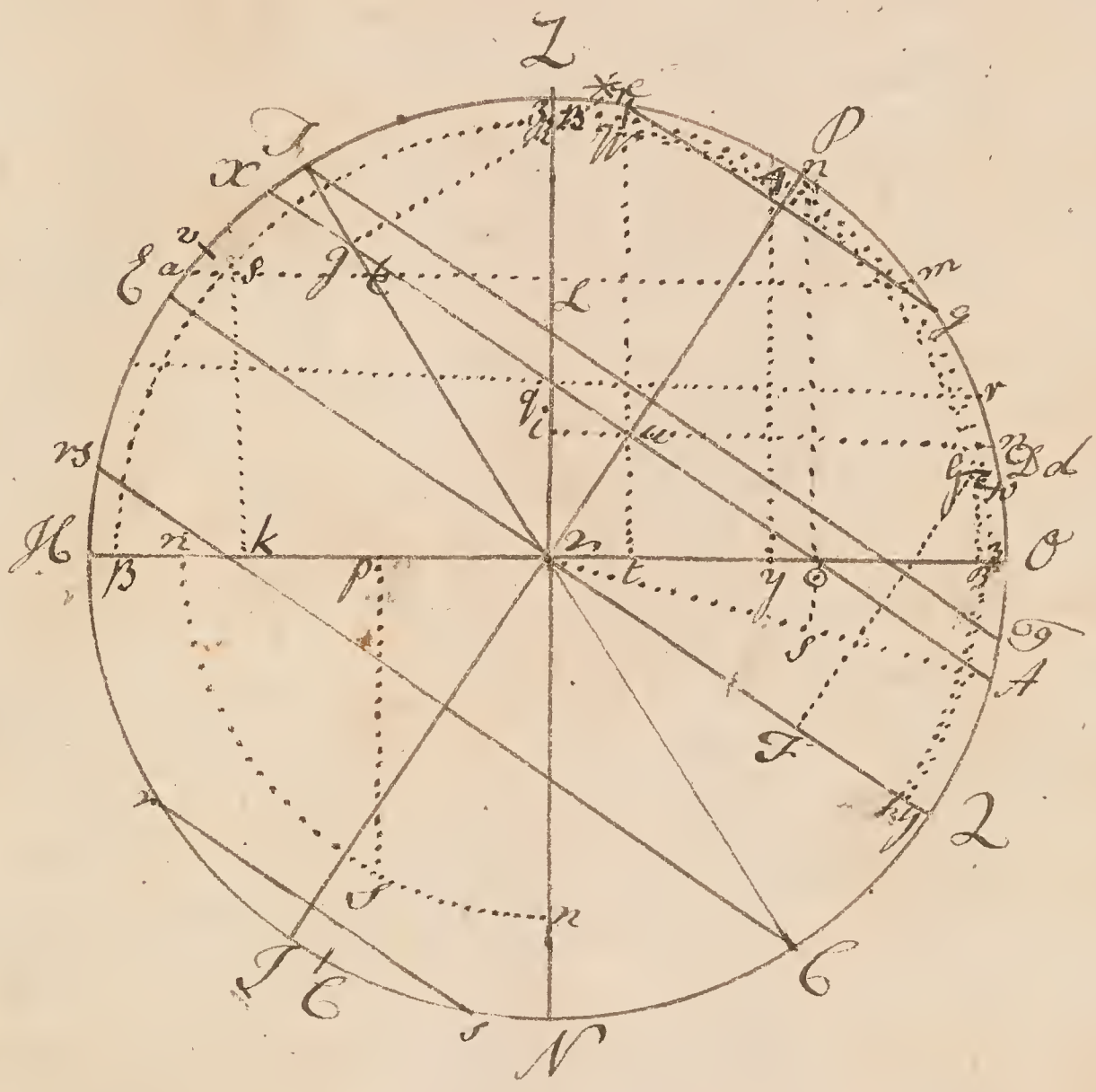
The Orthographick Projection of the Sphere is the drawing the Superfice thereof on a Pleine, which cutteth the Sphere in the middle wt respect to the Eye being placed perpendicular thereto and at an infinite distance therefrom. The following Example will illustrate the Projection.

Let it be required to project the Orthagraphick Sphere on the plane of the Meridian for the Lat: of 51° 10' North, the Sun's declination 18° North increasing.

First, with the Chord of 60 in your Compasses draw the primitive Circle P E I 2 to represent the Meridian, & cross it with two cross Diameters at right Angles in the Center, as H O which represents the Horizon, and I N the Prime Vertical; take ye Latitude 51° 10' from the Chord in your Compasses, & set upon the Meridian from O to P & from H to I; lay a Ruler upon P & I, & draw the Line P I to represent the Axis of the World, P being the North Pole & I the South Pole, then cross the Line P I at right Angles with the Diameter E 2, which represents the Equator; take the Chord of 18°, the Sun's declination, in your Compasses, & set from E to X & from 2 to A, & draw the Line X A for the parellel of the Sun's declination; take 23° 30' from the Chords & set from E to T & from E to S; set it also from 2 to 9 & from 2 to C, and draw the Line T 9 to represen

The

The Tropick of Cancer & the Line rs C to represent the Tropick of Capricorn, then draw T C to represent the Eclyptick; set of all on the Chord of 23° 30′ from P to e & from P to g & draw the Line eg to represent the Arctick Circle; set of also the same Chord of 23° 30′ from T to r & from T to s, & draw y^e Line rs to represent the Antartick Circle.



Problem 1. To find the Sun's Meridian Altitude.

The Sun's Meridian Altitude is the Arch H X on the left hand; take therefor H X in your Compasses, & apply it to the Scale of Chords, & will shew the Sun's Meridian Altitude to be in this example 50° 50′.

Note, In North Latitude, when the Sun is North Declination, ye Sum of the Complement of Latitude & the Sun's declination is the Meridian Altitude: But if the Latitude be South, then the difference between the Complement of Latitude & Sun's declination is the Meridian Altitude

Prob: 2. To find the Ascensional difference, time of Sun's rising & setting &c.

The Sun riseth at ☉, where the parallel of declination cuts the Horizon & the axis of ye World at u; take u X in your Compasses & set upon r o from r to R, upon r as a Center discribe the Quadrant R R cutting the Horizon & Prime Vertical each of them at R; take ☉ u in your Compasses & set one Foot upon r R from r to y, upon y erect a

Perpen-

Perpendicular reaching to R R at 4; lay a Ruler upon V & 4 to cut the Primitive Circle, which distance taken on your Compasses by the Line of Chords is the Complement of the Sun's Ascensional difference to 90 Degrees, & this Ex: is 59° 46' which being subtracted from 90° there remains 30° 14' the Suns Ascensional difference, which being conver:=ted into Hours, by allowing 15° to an Hour, is 2^h 1^m.

The Ascensional difference being found to find the time of Sun's rising & setting, take the following Rule.

The Sun's declination North, the difference between 6 Hours and y^e Sun's Ascensional difference is the time of the Sun's rising, which doub:=led is the Length of the Night, & y^e Sum of 6 Hours & Ascensional diffe:=rence is y^e time of the Sun's setting, wch being doubled is y^e Length of y^e Day. But in South declination 6 Hours added to the Ascensional difference is the Time of Sun's rising, & the Ascential difference is y^e time of Suns set:=setting. So in this Ex: the Ascensional difference being 2^h 1^m Subtracted from 6 Hours there remains 3^h 59^m for the time of the Suns rising at Ad^r, which being doubled 7^h 58^m for the length of y^e Night; again by adding 2^h 1^m to 6^h, & totall, which is 8^h 1^m, is the time of the setting, wch being doubled is 16^h 2^m for the Length of the Day. Note, When any Arch of a Vessel Circle is required to be measured, it must first be reduced to y^e Common Radius, & y^e proceed to measure as in y^e preceding Problem.

PROB: 3. To find the Amplitude of the Sun.

Take V O in your Compasses, & measure it by a Line of Signs an:=swerable to the Radius that your Sphere was projected by, & that shows the Suns Amplitude always of the same Name with y^e declination. But if you have not a Line of Signs, upon the point O, where the parellel of Declination cuts the Horizon, erect a Perpendicular to cut the primitive Circle in n; So shall O n, Measured by the Scale of Chords, be the Compli:=ment of Altitude to 90°, which being subtracted out of 90° there re:=mains 34° 45'. the Suns Amplitude, wch shews y^t y^e Sun riseth NE by E fere.

PROB: 4. To find the Sun's Azimuth at rising & setting.

Find the Sun's Amplitude by the preceeding Problem, & sub:=tracting it (when the declination & Latitude are both North) from 90°, there remains the Suns Azimuth from the North at rising, which being subtracted out of 180° there remains his Azimuth from the South; For by adding 90° to the Amplitude, you have his Azimuth from y^e South: And this Ex: his Azimuth from the North is 55° 15', which being subtracted from 180°, there remains 124° 45' from the South: But in North Latitude y^e Sun having North declina:=tion, by adding 90° to y^e Amplitude you have his Azimuth from y^e North at rising.

Prob: 5. To find the Sun's Azimuth at 6 hours in ye Morning or Evening.

Through u run a Line parellel to r O, as n i, cutting ye Primitive Circle in n & the prime Vertical in i; take i n in your Compasses & set upon r O from r to 3, upon r as a Center dran the Quadrant 3 3; that done, take i u in your Compasses & set upon r K, from r to t, on t erect a perpendicular as t s cutting the Quadrant 33 in s; lay a ruler upon r s to cut the primitive Circle in 7, r o is O 7, measured on the Chords, the Sun's Azimuth from the North, wch being subtracted from 90° remains his distance from the East at 6 hours, & in this Ex: is 9^d° 59'; & by consequence his Azimuth fm the North 80° 1', so that at 6 hours in the Morning the Sun is E by N 1° 16' Easterly, & in the Afternoon 1° 16' Westerly.

Prob: 6. To find the Sun's Altitude at the Hour of 6.

Take u t in your Compasses, & measure it on the Line of Signs it sheweth the Sun's Altitude at the Hour of 6, & is 15° 3', or the Arch O n of ye primitive Circle, measured on the Line of Chords, is the Sun's Altitude at the Hour of Six.

Prob: 7. To find the Sun's Altitude when due East or West.

The Sun is due East & West when the parellel of declination cuts ye Prime Vertical as at q take r q in your Compasses & measure it on ye Line of Signs & that shews the Sun's Altitude when due East or West & in this Ex: is 21° 35' but if you have not a Line of Signs run a Line thro' q pearallel to H O cutting the primitive Circle in r so is O r, measured on ye Line of Chords, on the primitive Circle the Altitude required:

Prob: 8. To finel the Sun's Altitude at any Hour of the Day.

For Ex: Let it be required to find the Sun's Altitude at the Hour of 9 in the forenoon; take 45°, which is equal to 3 hours of time, to wit the hours from 12 in ye forenoon, & lay upon the primitive Circle from 2 to D d, take x u in your Compasses & upon r as a Center describe the Quadrant W h; lay a Ruler upon r D to cut the Quadrant in G, let fall a Perpendicular from G to r 2 as G F; take r F in your Compasses & lay upon the Parellel of Declination from u to e the place of the Sun at the hour of 9, r un a line through e parellel to the Horizon cutting the primitive Circle in a & m, so is H a or O m measured on ye primitive Circle by the Line of Chords the Sun's Altitude at the Hour proposed, which in this Ex: is 38° 29'.

Prob: 9. To find the Sun's depression at Midnight.

When the Sun's declination is North, Subtract the declination out of the Complement of Latitude, ye Rem^r is the Sun's depression at Midnight; so O A in this Ex: being measured on the Chords is ye Suns depression at Midnight, & is 14° 50'

Prob: 10. To find ye Sun's Azimuth at any hour of ye Day from the North or South.

Let the Hour be 9 in ye forenoon, at which it is required to find the Sun's Azimuth from the North or South: having found ye Sun's Altitude at the present hour by the preceding Problem, & drawn the Parellel of Altitude a m cutting the prime vertical in L, take a L in your compasses and set upon r H, from r to n, & draw ye Quadrant n n; take L e in your compasses & set upon r n from r to p, upon p erect a Perpendicular to the Line r n, which being continued will cut the Quadrant n n in s: lay a Ruler upon r & s to cut the primitive Circle in E so shall H E measured on the Chord be the Sun's Azimuth from the South, whose Complement to 180° is his Azimuth from the North, & in this Ex: is 120° 47'.

Prob: 11. To find the Suns Longitude in the Ecliptick.

The Sun's place in the Ecliptick is at q, where the declination cuts the Ecliptick; take therefor r q in your compasses and apply it to a Line of Signs, it shews the Sun's Longitude from the nearest Equinoctial point, & to find the said point this is ye Rule: If the Suns declination be North increasing, then the nearest Equinoctial point is r; but if ye declination be North decreasing, & then the Longitude found out by this Prob: must be subtracted out of 180° to give the Longitude for ye 1st point of ♈: But if the Declination be South increasing, ye nearest Equinoctial point is ♎; but if the declination be South decreasing the nearest Equinoctial point is r, so in this Ex: the declination is 18° increasing & his place 50° 48' from ye 1st point of r, & by allowing 30° to a Sign, the Sun is in ♉ 20° 48'; but if you have not a Line of Signs, upon ye Point q erect a Perpendicular to the Ecliptick to cut the primitive Circle in ✳, so is ✳ ye Complement of Longitude to 90°, & is 39° 12'.

Prob: 12. To find the Suns Declination.

Through ☉, ye Sun's place in ye Ecliptick, draw a Line parellel to ye Equator cutting ye primitive Circle in X & A, so is q ☉ or e X the Sun's declination & in this Ex: is 18° North increasing, ye Sun being in the 1st Quarter of ye Ecliptick.

Prob: 13. To find the Sun's right Ascension, his place in the Ecliptick & present declination being known.

Let the Sun's place in the Ecliptick be in ♉ 20° 48' North, declination 18° increasing; take u X in your compasses & set on r H from r to B, & upon r as a Center describe the Quadrant B B; take u e in your compasses & set upon r B from r to k, upon k erect a Perpendicular as k s cutting the Quadrant B B in s; lay a Ruler upon r & s to cut the primitive Circle in v, so shall h v measured on ye Scelle of Chords be the Complement of the Sun's right Ascension to 90°, & in this Ex: his right Ascension is 48° 25'.

N: B: This only finds his right Ascension in ye 1st Quarter of the Eclyptick; but when he is in the 2d Quarter subtract it out of 180°, the Remr is his right Ascension: & when he is in ye 3d Quarter add it to 180° gives the right Ascension from ♈ & when he is in the 4th Quar: =ter subtract it out of 360 the Remr, is his right Ascension.

Prob: 24. To find the Suns Horary distance from ye Meridian, his Altitude being known.

Let the Sun's Altitude in the forenoon be observed to be 38°29'; having drawn the parellels of Altitude a m, mark where it cuts ye Parellel of Declination as at q; take u x in your compasses & set upon r 2 from r to z, upon r as a center describe ye Quadrant y Z; take u q in your compasses & set r q from ~~from~~ r to n, upon n, e: =rect a Perpendicular to cut the Quadrant in c; lay a Ruler upon r & c to cut the pripitive Circle in D, so is 2 D measured on the Line of Chords, & converted into time, the Complement of the Hour from Noon, is being subtracted from 12 Hours shews the Hour of ye Day, & in this Ex: is 9 of Clock: But if the observation be taken in the Afternoon, then the Hour would have been 3 of Clock.

Note, Another way to reduce the Arch of a Lesser Circle to the Arch of a Greater, as for Ex: in Prob: 2nd in finding the Ascentional difference, let it be required to reduce the Arch u ☉ to the like Arch of r 2; first draw r A & r S, joining u A in A; draw a line thro' ☉ parellel to r u as ☉ s, so is r s equal to ☉ u, wch measured on the Signs shews the Ascentional differance to be 30°14' as before; for it is plain as u A: r A :: u ☉: r s.

Some Definitions & Problems of Spherical Geometry prepa-ratory to the Stereographick projection of the Sphere.

All the Circles of the Sphere are ither Great Circles, which di-vide it into two equal Parts; or Lesser, wch divide the Sphere into two un-equal parts.

The Plane of a great Circle, on wch the Projection is made, is cal-led the Primitive Circle, and is here represented by the following Circle A B C D. A Great Circle & an Oblique Circle being duly considered are the subject matter of Spherical Geometry.

Prob: 1. To find the Pole of a great Circle.

Def: The Pole of a Great Circle is point 90° distant from it, In this Prob: are the three following Cases.

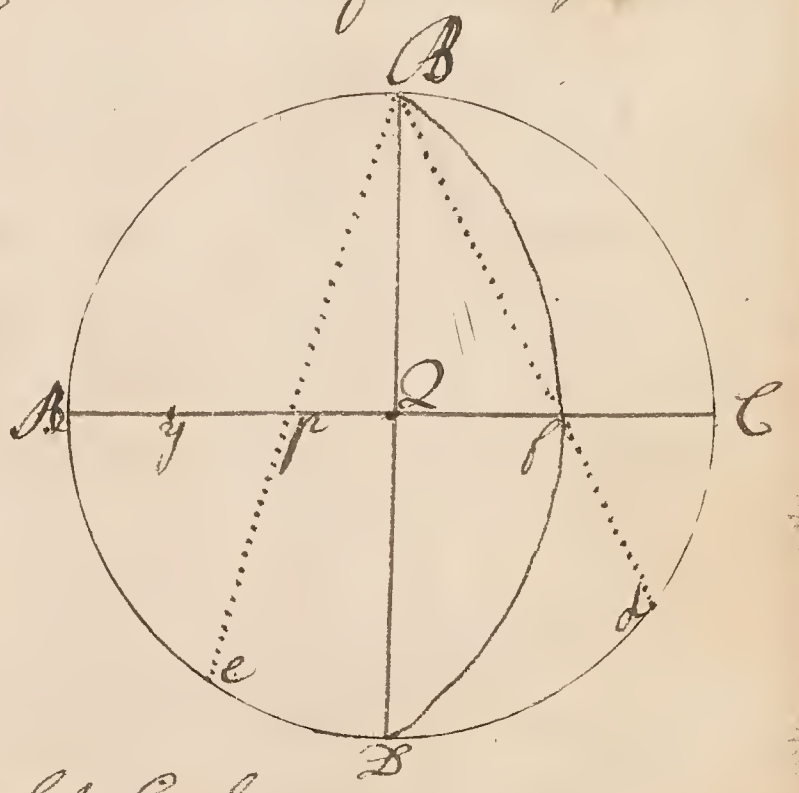
Case 1. To find the Pole of the primitive Circle as A B C D.

Rule Find the Center of the primitive Circle & it is the Pole thereof be-ing 90° distant therefrom.

Case 2. To find the Pole of a right Circle. Def: A right Circle passeth through the Center of a pri: -mitive Circle, & in the Projection is a Demater, and by consequence its Pole will be at the primitive Circle.

Let A B C D be the primitive Circle, whose Center is 2, & let the right Circle be A 2 C whose Pole is required.

Take 90° of the Line Chords, and lay upon the primitive Circle from A to B or from C to B, so is B the Pole required; or cross the given right Circle with a-nother right Circle or Demater as B 2 D, so is B or D the Pole of the given right Circle.



Case 3. To find the Pole of an Oblique Circle. Def: An Oblique Circle passeth thro' the Center of a right Circle, and in the Projection is re-presented by an Arch as B f D. N: B. The Pole of an Oblique Circle ly-eth between the Centers of the primitive & right Circles.

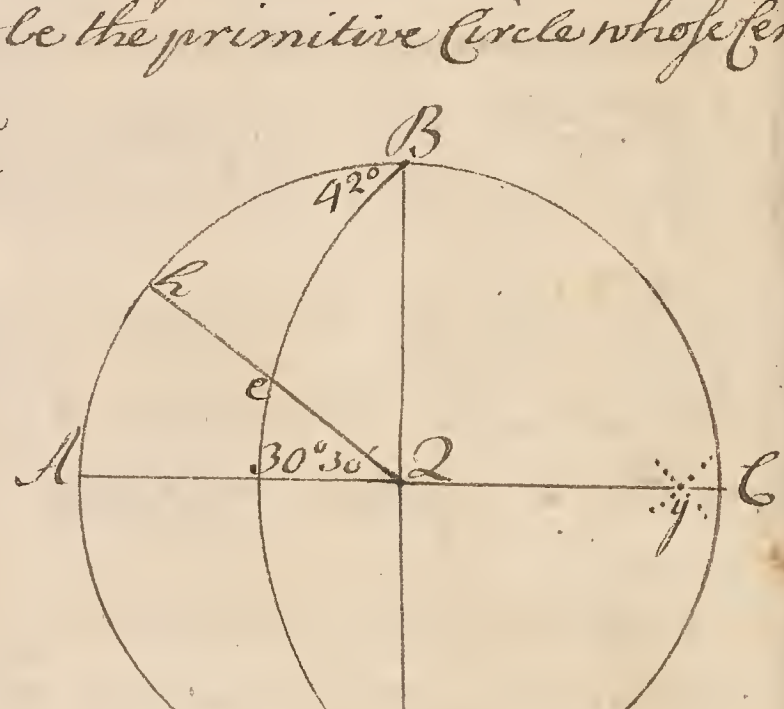
Let A B C D be the primitive Circle whose Center is 2, & B F D & Oblique Circle whose Center is y & whose Pole is required. First bissect the other Cir-cle by drawing a Deameter thro' the middle thereof cuting & sam in f: lay a Ruler upon B & f to cut the primitive Circle in d, take 90° on y Chords & lay upon y primitive Circle from d to e, & lay a Ruler upon B y e to cut

The foresaid Deameter at ꝑ the Pole requiree.

Prob: 2. To describe a Spherical Angle.

Def: A Spherical Angle is made by the intersection of two great Circles, the point of intersection being the Angular Point. In this Prob: are two Cases:.

Case 1. To describe a Spherical Angle, when the Angular point is at ye Center of the primitive Circle. Such an Angle is made in all respects like a Plain Angle. Ex: Let A B C D be the primitive Circle whose Center is 2, & it is required to make ye Angle B 2 H of 36° 30'. The Angular point 2 being at the Center of the primitive Circle, take the Chord of 36° 30' in your Compasses & lay upon the primitive Circle from A to H, & draw the right Circle H 2 and it is done.

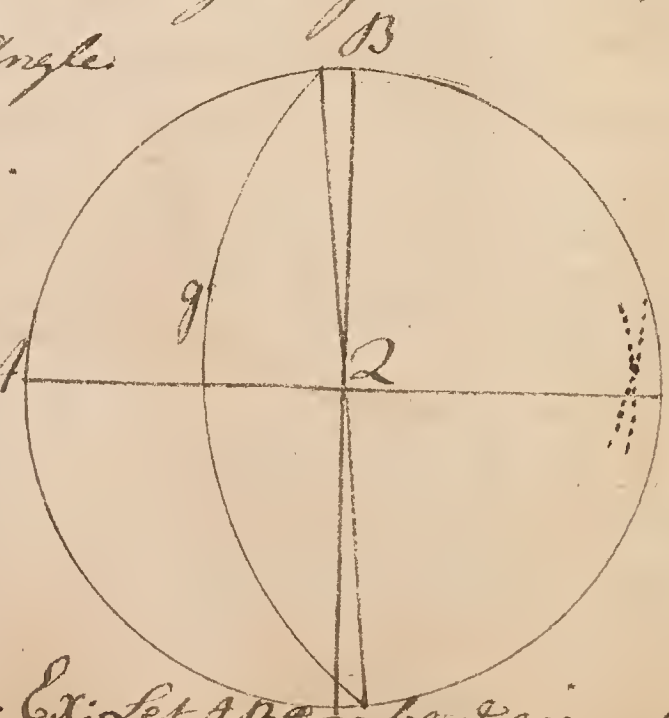


Case 2. To describe a Spherical Angle, when the Angular point is at the primitive Circle. Such an Angle is described by draving an Oblique Circle with the Secant thereof. Ex: Let A B C D be the primitive Circle whose Center is 2, & it is required to make the Angle h B e at the primitive Circle equal to 42°. Draw a Deameter from B thro' 2 as B 2 D, take ye Secant of 42° in your Compasses from the Line of Secants, & setting one foot on B draw an Arch, wt that extent set one foot on D & ye other intersect the former Arch at y the Center of the Oblique Circle, wt that same extent set one foot on y and draw the Oblique Circle B E D, so shall ye Angle H B E be an Angle of 42 Degrees.

Prob: 3. To draw a great Circle through a given Point, so as it may make wt ye primitive Circle a given Angle.

With the Tagent of the given Angle set one foot on 2, ye Center of ye primitive Circle, & draw an Arch, wt ye Secant of the same Angle, set one foot on the given Point & intersect ye former Arch, & ye point of intersection is ye Center of the Oblique Circle required to be drawn.

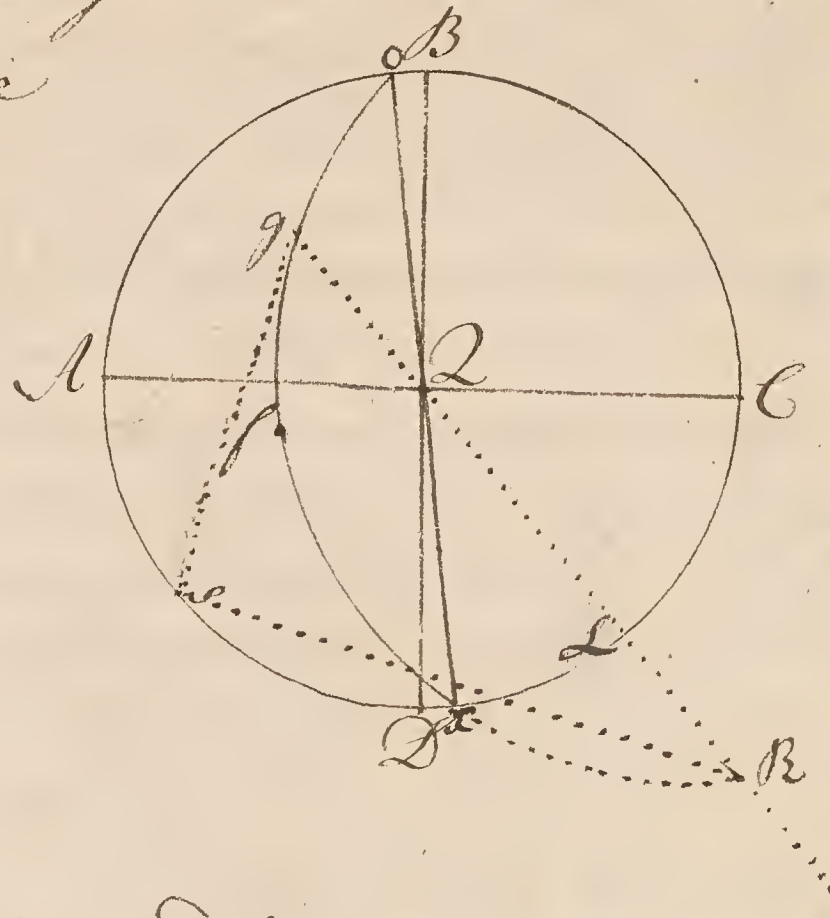
Note, The given point must be at such a distance from ye Center of ye primitive Circle as ye Tangent & Secant may cut one another, otherwise 'tis impossible.



Ex: Let A B C D be ye given Circle whose Center is 2, & ye given point g, 'tis required to draw a great Circle thro' g to make a

Angle with the primitive Circle of 42 Degrees.

Prob: 4. Two points being given within the primitive Circle to draw a great Circle through these two.



Let A B C D be ye primitive Circle whose Center is 2, & let ye two given Points be g & f; Thro' g the remotest point draw a line through the Center 2 indefinitely, as g 2 M, cutting the Primitive Circle in L, take ye Chord of 90° & lay upon the primitive Circle from L to s, draw a line from g to s, & upon that Line at the point s erect a Perpendicular to cut the Line g 2 & M in R a third point, then thro' the three points g, f, R, draw ye Circle g f x R (by Prob: before Dialing) cutting ye Primitive Circle in two points Deametrically opposite; so is g f x ye Great Circle required.

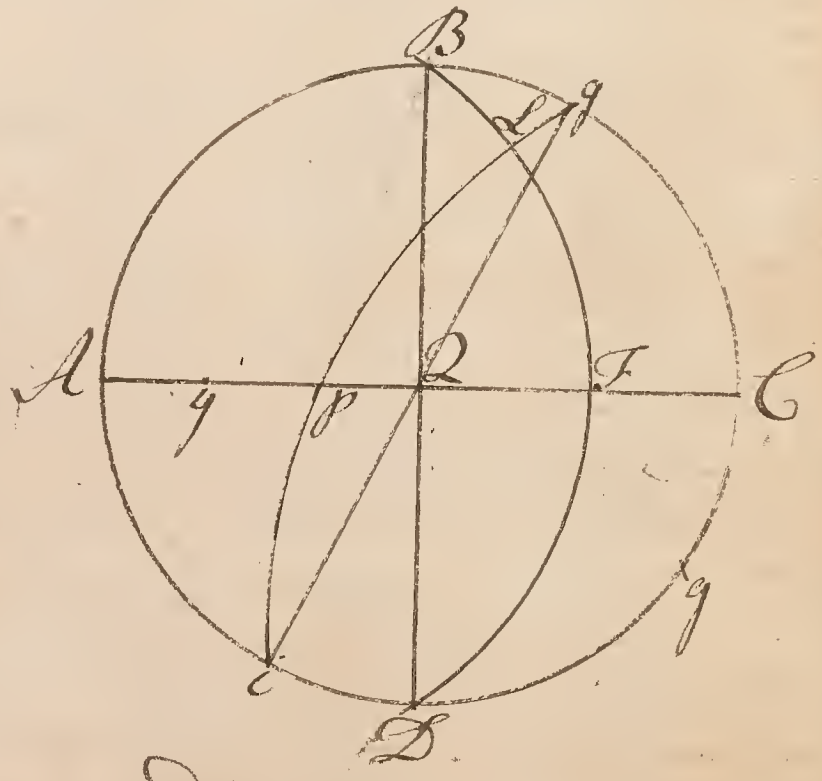
Prob: 5. To draw a great Circle perpendicular to another great Circle. In this Prob: are the four following Cases:

Case 1. To draw a great Circle perpendicular to ye Primitive Circle.

Draw a Deameter thro' the Pole or Center of the Primitive Circle, and it is done. Ex: Let A B C D be the primitive Circle whose Center is 2, & it is required to draw a great Circle perpendicular thereto: Through 2 ye Pole of the Primitive Circle draw A 2 C, & it is perpendicular to ye Primitive Circle.

Case 2. To draw a great Circle perpendicular to a Right Circle given.

Find the Poles of the given right Circle by Prob: 2, & draw a Deameter thro' the Poles, & it is done. Ex: Let A B C be the Primitive Circle whose Center is 2, & A 2 C the right Circle given, it is required to draw another right Circle perpendicular thereto: draw the Deameter B 2 D perpendicular to A 2 C, & it is done.



Case 3. To draw an Oblique Circle perpendicular to a given right Circle.

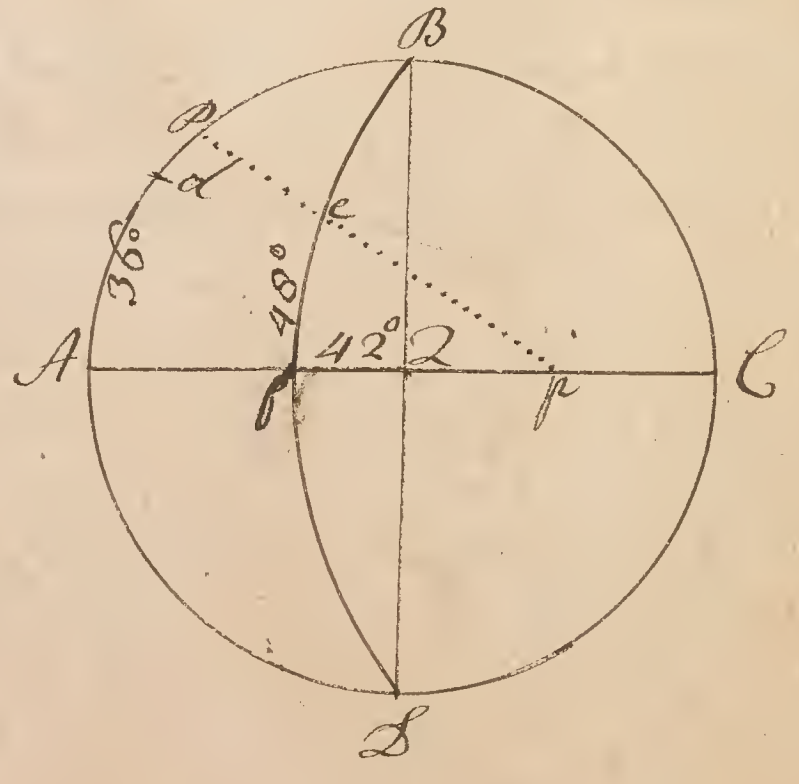
Draw

Draw an Oblique Circle thro' the Poles of the great Circle, & it is done. Ex: Let A B C D be the Primitive Circle whose Center is 2, & the given right Circle A 2 C, it is required to draw an Oblique Circle perpendicular thereto: The Poles of the given right Circle are found out by Prob: 1 Case 2. to be B & D, thro' which draw the Oblique Circle B F D cutting the given right Circle at F. Note, If 2 F be limited, then thro' B F D draw a Circle by Prob: 3: Or, if 2 F be known in Degrees, then ꝉ the Secant of y^e Com: =plement draw the Oblique Circle B F D by Prob: 2. Case 2 & it is done.

Case 4. To draw an Oblique Circle perpendicular to an Oblique Circle given. Find the Pole of the given Oblique Circle by Prob: 1 Case 3, then thro' the Pole draw a great Circle cutting y^e Primitive Circle at two points Diametrically opposite, & it is done. Ex: Let the Primitive Circle be A B C D whose Center is 2, B F D the Oblique Circle given whose Center is g, it is required to draw an Oblique Circle perpendicular thereto: Having found P the Pole of ye Oblique Circle given draw the Oblique Circle i P g which shall cut the given Oblique Circle at right Angles in L, & it is done. Note, If the point of the given Oblique Circle be limited, then draw a Circle thro' that Pole & ye given point by Prob: 4; or if it be required that the said Oblique Circle shall make a certain Angle ꝉ the Primitive Circle, y^n proceed as in Prob: 3.

Prob: 6. To lay any Quantity of Degrees upon a great Circle. In this Problem ar three Cases..

Case 1. To lay any Quantity of Degrees upon the primitive Circle. Ex: Let the Primitive Circle be A B C D whose Center is 2, it is required to lay 36° thereon from A. Take 36° from the Scale of Chords & lay upon the Primitive Circle from A to d, & it is done.



Case 2. To Lay any Quantity of Degrees upon a right Circle. If the part of y^e right Circle, that the Degrees are to be laid upon, lie next ye Center of the Primitive Circle take the Degrees required to be laid off from the Scale of Semi-Tangents forward & lay upon the said right Circle: But if it be required to lay any Quantity of Degrees upon a right Circle that lyeth next the Periphery of ye primitive Circle take

The

The Degrees from the Scale of Semi-Tangents beginning at 90°, and counting 80 for 10, 70 for 20, &c, and it is done. Ex: Let the primitive Circle be A B C D whose Center is 2, & A 2 C the right Circle given, on which it is required to lay 42°: From 2 the Center of the Primitive Circle take 42° from the Scale of Semi-Tangents, beginning at the Brass point & lay upon the said right Circle from 2 to f towards A, & it is done.

Case 3. To lay any Quantity of Degrees upon an Oblique Circle.

Take the Degrees required to be laid off from the Scale of Chords & lay upon the primitive Circle, then lay Ruler upon the Pole of y Oblique Circle & the extremities of the Arch, & will cut the Oblique Circle in two Points; the Arch intercepted between these two points is the Degrees required to be laid off. Ex: Let the Primitive Circle be A B C D whose Center is 2, & B f D the Oblique Circle, & it is required to lay 48° thereon from f to e towards B: Through p & f draw a Diameter cutting the Primitive Circle in A, take the Chord of 48° & lay upon the primitive Circle from A to P, lay a Ruler upon p the Pole of the Oblique Circle and P to cut the Oblique Circle at e, and it is done.

Prob: 7. To measure any part of a great Circle. In this are the three following Cases being the convers of the last.

Case 1. To measure any part of the Primitive Circle. Ex: Let the primitive Circle be A B C D whose Center is 2, & it is required to measure the Arch A d: Take A d in your Compasses, & measure it on the Line of Chord, & it shows the measure thereof, which in this Ex: is 36°.

Case 2. To measure any part of a right Circle. Ex: Let the Primitive Circle be A B C D whose Center is 2, & A C the right Circle given & it is required to measure 2 F. Seing the part to be measured lyeth next the Center of the Primitive Circle, measure it on the Scale of Semi-Tangents forward, & it is 42°: But if the part of the Circle to be measured lies next the Periphery of the Primitive Circle as A F then it is measured from y Scale of Semi-Tangents backward, & in this Ex: is 48°.

Case 3. To measure any part of an Oblique Circle. Ex: Let the Primitive Circle be A B C D whose Center is 2, & B F D an Oblique Circle. Lay a Rule upon the Pole of the Oblique Circle & the extremities of the Arch to be measured to cut the Primitive Circle at A & P, so shall A P measured on the Primitive Circle be 48° of the Line of Chords and is the Measure of the Oblique Circle f. which was to be done.

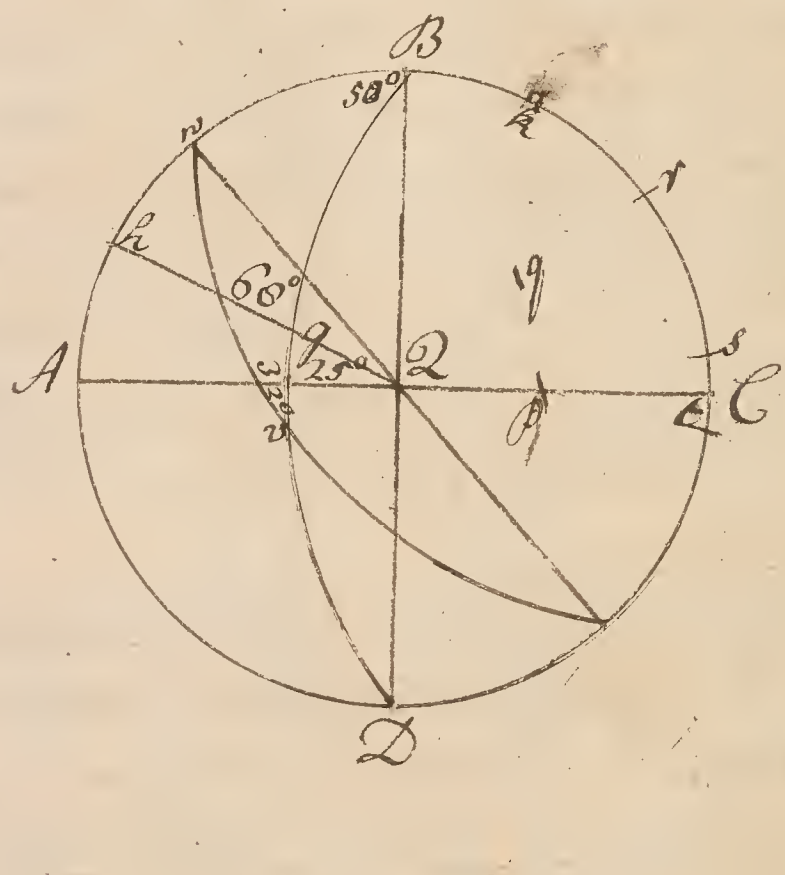
Prob: 8.

Prob: 8. To measure any Spherical Angle. In this Problem are four Cases, for wch take this general Rule; Viz,

A Spherical Angle is measured by that Arch of a great Circle intercepted between the two sides that contain the Angle: The Angular point thro' the Pole of that great, or the distance of the Pole with the containing sides, is equal to the Measure of the contained Angle.

Case 1. To measure an Angle, when the Angular point is at the Center of the Primitive Circle. Such an Angle is measured in all respects as a plain Angle with the help of the Line of Chords. Ex Ex: The primitive Circle is A B C D whose Center is 2, & it is required the Angle A 2 F, & the Arch A F on the primitive circle measured on the Line of Chords will be 25°.

Case 2. To measure an Angle, when the Angular point is at the Periphery of the Primitive Circle. Ex: Let the Primitive Circle be A B C D whose Center is 2, & it is required to measure the Angle h B g; The two containing sides are B h (an Arch of the Primitive circle whose Pole is 2) & B g, (an Arch of the Oblique Circle whose Pole is p) and y distance 2 p the two Poles of y sd Circle measured on y Scale of Semi-Tangents forward is 50° equal to h B g which was required.

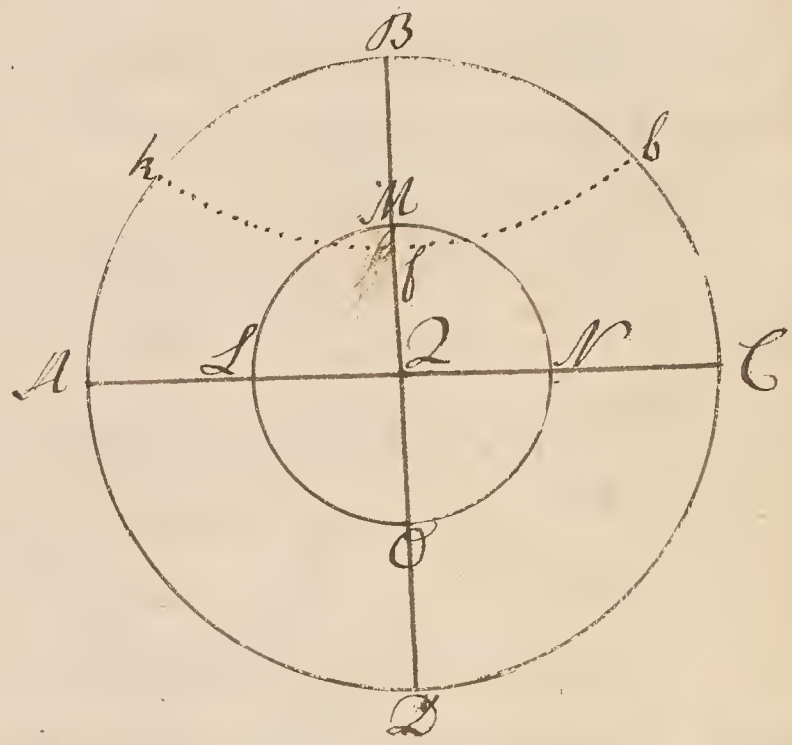


Case 3. To measure an Angle, when the Angular point is neither at the Center nor Periphery of the Primitive Circle. Ex: Let A B C D be the Primitive Circle whose Center is 2; & it is required to measure the Angle F g B, whose two containing sides are h g (whose Pole is h) & B g, (whose Pole is p) lay a Ruler upon P & g to cut the Primitive Circle in t, so is h t y Arch of the Primitive Circle measured on the Chords, & is 68° the Measure of y Angle h g B. Note, That if the Angle be otherwise, h t in that Case is the Complement to 180 Degrees.

Case 4. To measure an Angle, when both sides are Arches of Oblique Circles. Ex: Let A B C D be the Primitive Circle whose Center is 2, & 'tis required to measure the Angle n v B: The Pole of the B v is P and Pole of n v is q, lay a Ruler on v & P to cut the Primitive Circle in s, again lay a Ruler on v & q to cut the primitive Circle in r: so is r s on the Primitive Circle & taken from the Line of Chords the measure of the Angle n v B, & is 32 Degrees.

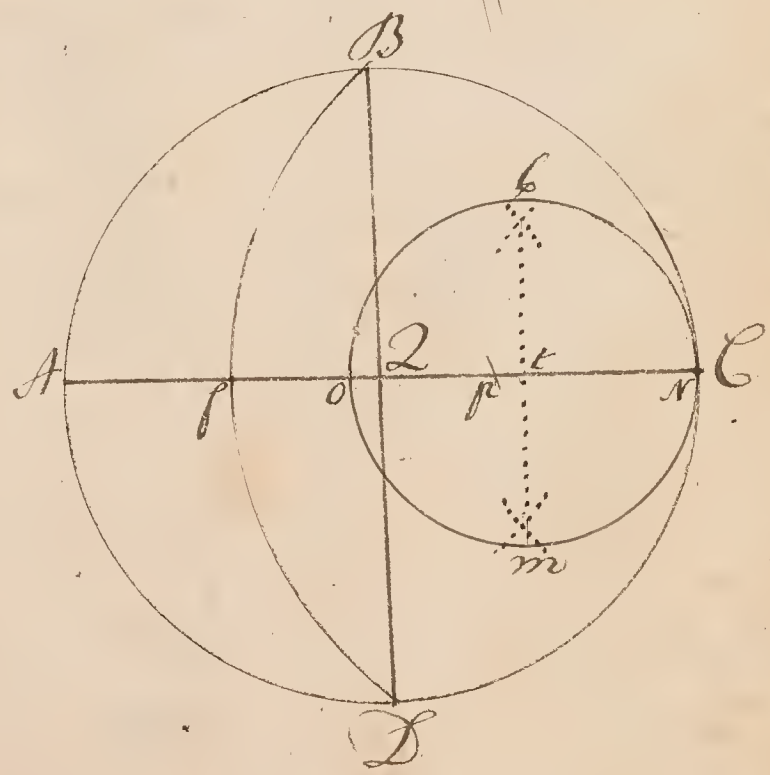
Prob. 9. To draw a Parellel circle. Def: A Parellel, or Lesser circle, divideth the Sphere into two unequal Parts or Superfi:cies, & lyeth always parellel to a great circle. In this Problem are 3 cases.

Case 1. To draw a circle parellel to the Primitive circle. Draw it from the Pole or Center of ye Primitive circle, with the complement of the given distance taken from the Scale of Semi-Tangents. Ex: Let A B C D be the Primitive circle whose center is 2, and 'tis required to draw a circle parel:lel thereto at 40° distance: With 50°, the Complement of the said distance, taken from the Scale of Semi-Tangents set one foot on 2, & ye other describe the Parel:lel circle L M N O & it is done.



Case 2. To draw a circle parellel to a right circle. Ex: Let the Primitive circle be A B C D whose center is 2, & A 2 C ye right circle given, 'tis required to draw a right circle parellel thereto at 40° distance. Take 40° from the Scale of Chords & lay upon the Primitive circle from A to k & from C to b, take the Tangent of the Complement of the Parelles distance in your compasses, & set:tle on foot on k with the other describe an Arch, ye same extent set one foot on b & interset that Arch, upon ye point of interfection as Center describe the Circle k f b, which is the Parellel required.

Case 3. To draw a Circle parellel to an Oblique Circle at any given distance. Ex: Let the Primitive Cir:cle be A B C D whose Center is 2, & the Ob:lique Circle B f D, it is required to draw a Circle parellel thereto at 40° distance. First, find the Pole of the given Oblique Circle which is p, then measure on the Scale of Semitangents the distance 2 p & Poles of the Primitive & Oblique Circles, wch admit to be 40°, then add to it 50° the Com:plement of the Circles distance, it will make 90°, & also subtracting from it 50°, or subtracting it from 50, it will make 10°: Then this Sum & difference taken from the Semi-Tangents, & set each way from p, will give the Diameters two extreams O & N, or the Point of intersection of the Parellel, & then the middle dis:tance betwen O & N is ye Center of ye Circle o b N m wch is parellel to B F D & at ye given distance: Or, The S: T of 90° set fm 2 will give N; & ye S.T. of 10° set also fm 2 will give O.

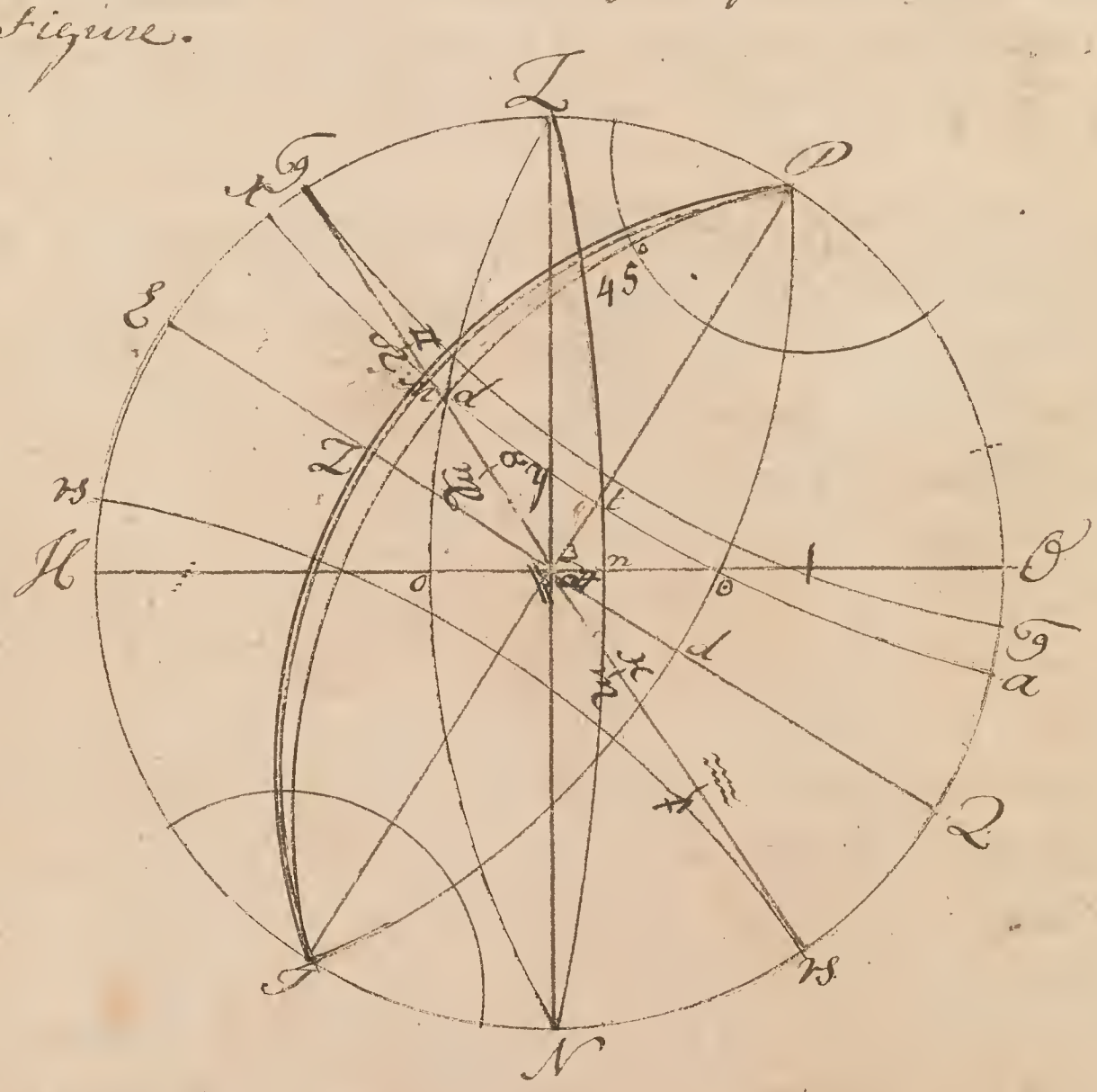


The Stereographick Projection of the Sphere

is the draving of the Sphere on a Plane, which cutteth it in the middle, & respect to the Eye being placed on the Superfice of the Sphere at the Pole of that Circle on whose Plane the Projection is made.

To project the Sphere Stereographically upon the Plane of the Meridian of the Lat: of 57° 10' North, the Sun having 18° of North Declination increasing,

First, With the Chord of 60° describe the Primitive Circle HZON representing the Meridian, & place A at the Center, then draw HAO the Horizon ZAN the Prime Vertical, PAP the Axis of ye World, & EAQ the Equinoctial, as before in the Orthographick Projection; That done, take 23°30' from the Line of Chords & lay upon the Primitive Circle both ways from E to ♋ & from E to ♑, & set the same likewise from Q both ways to ♋ & ♑, & by Prob: 9 Case 2 of the foregoing Spherical Geometry draw the Tropicks of ♋ & ♑, then draw the Ecliptick & insert the 12 Signs thereinby the help of a Scale of Semi-Tangents, & draw the Parelles of declination X & the Polar Circles by the forsaid Prob: & Case, as in the following Figure.



Problem 1. To find the Suns Meridian Altitude.

Take the Arch of the Primitive Circle HX in your Compasses, &

Mea-

Measure it on the Scale of Chords, & shows the Sun's Meridian Altitude to be in this Example 50° 50'

Prob: 2. To find the Ascensional difference, or time of Suns rising & setting, & length of the Day & Night.

The Sun riseth at o, where the parellel of declination cuts the Horizon; therefor thro' o' (by Prob: 5 Case 3. of Spherical Geometry) draw a great Circle as P o I perpendicular to the Equinoctial cutting the same in d, measure A d (by Prob: 8 Case 2) which in this Ex: is 30° 14' the Ascensional difference, and being converted into time is 2^h 1^m, which being subtracted from, & added to, 6 hours the Remainder is the time of Suns rising, & the total the time of his setting; so that the Sun riseth in this Ex: 1 min. before 4, & sets one Minut after 8. The length of the Day & Night is found as on the Orthagrafick Projection.

Prob: 3. To find the Sun's Amplitude.

The Sun's Amplitude from the East is the Arch of the Horizon A o: Take therefor A o in your Compasses, measure it on ye Scale of Semi-Tangents, & it shows the Sun's Amplitude at rising to be 34° 45'.

Prob: 4. To find the Sun's Azimuth at rising & setting.

Having found the Sun's Amplitude, subtract it from 90° remains the Sun's Azimuth at rising from the North, which being subtracted from 180° remains his Azimuth from the South.

Prob: 5. To find the Sun's Azimuth at 6^h in ye Morening or Evening.

The Suns place at 6 hours is at t, where the declinations cuts the Axis of the World; therefore thro' t draw a great Circle (by Prob: 5 Case 3) perpendicular to the Horizon cutting the same in n, so is A n measured on the Semi-Tangents the Suns Azimuth from the East at rising, which being subtracted from 90° leaves his Azimuth from the North at rising.

Prob: 6. To find the Sun's Altitude at the hour of 6.

The Sun's place at 6 is where the declination cuts the Axis of the World, & the Arch n t of the Oblique Circle (measured by Prob: 7 Case 3) shows it to be in this Ex: 15° 3'.

Prob: 7. To find the Sun's Altitude when due East & West.

The Sun is due East & West when the parellel of declination cuts ye Prime Vertical as at y: measure A y the Arch of ye Prime Vertical by Prob: 7 Case 2, and it shows the Sun's Altitude ye due East & West to be in this Ex: is 21° 35'.

Prob: 8. To find the Sun's Altitude at an hour of the Day.

Let it be required to find the Sun's Altitude at the hour of 9; subtract the Hour proposed from 12 o Clock & convert the Remeainder into Degrees, then draw an hour Circle thro' P & ♈ at 3 hours distance from the 12 hour by Prob: 2 Case 2, mark where it cuts the parellel of Declination at d the Sun's place at ye time of Observation, then thro' Z d N draw an Azimuth cutting the Horizon in o and the Arch o A measured by Prob: 1 Case 3 gives the Sun's Altitude & in this Ex is 38° 29.

Prob: 9. To find the Suns depression at Midnight.

The Arch of the Primitive Circle from a to 8 measured on the Scale of Chords gives it, and in this Ex: is 14° 50'.

Prob: 10. To find ye Suns Azimuth at any hour of ye Day from North or South

Let the Sun's Azimuth at 9 hours in ye Morening & 3 in ye Afternoon be required; having drawn the hour Circle & Azimuth Circle thro' d, where ye parellel of declination cuts the hour Circle, the Angle D Z d is the Suns Azimuth from ye North, & in this Ex: is 59° by Prob: 8 Case 2, v^e being subtracted out of 90° is his Azimuth from the South, ~~which~~ being in this Ex: 31°.

Prob: 11. To find the Sun's Longitude in the Eclyptick.

The Sun's place in the Eclyptick is where ye declination cuts ye Eclyptick ♈ is at M, take therefore ♈ M in your Compasses & measure it on the Scale of Sem: Tan: & that sheweth the Sun's nearest distance from ye Equinoctial point, ♈ in this Ex: is ♈, and so the Sun's Longitude is 80° 48' from ♈, and by Consequence his place in ♉ is 20° 48'.

Prob: 12 & 13. To find the Sun's declination, and right Ascension.

Through M, the Suns place in the Eclyptick, draw a great Circle cutting the Equinoctial at right Angles in L, so is A L the Suns right Ascension, & L M his present declination; by Prob 2 Case 2 & 3 the Suns right Ascension will be found to be 48° 2', he being in the first Quarter of the Eclyptick, and his present Declination is 18 Degrees

Prob: 14. To find the Suns horary distance from the Meridian, his Altitude being knowen.

The Sun's Altitude observed in the Forenoon being 38° 29' I demand the Hour of the Day for the Lat: of 57° 10' North? Draw the Parallel of Altitude C ♈ R cutting ye Parallel of Declination in t, thro' t draw an Hour Circle, then shall ♈ 3 an Arch of the Equinoctial be the Hour from Noon in Degrees, ♈ being converted into Hours is 3 o Clock, which being subtracted from 12 remains 9 Hours for the Hour of the Day required.

Of a Circle & it's Parts.

1. A Circle is a plain Figure contained under one Term or Line, called the Circumference, and by some the Perimeter, or Periphary, as A B C D.

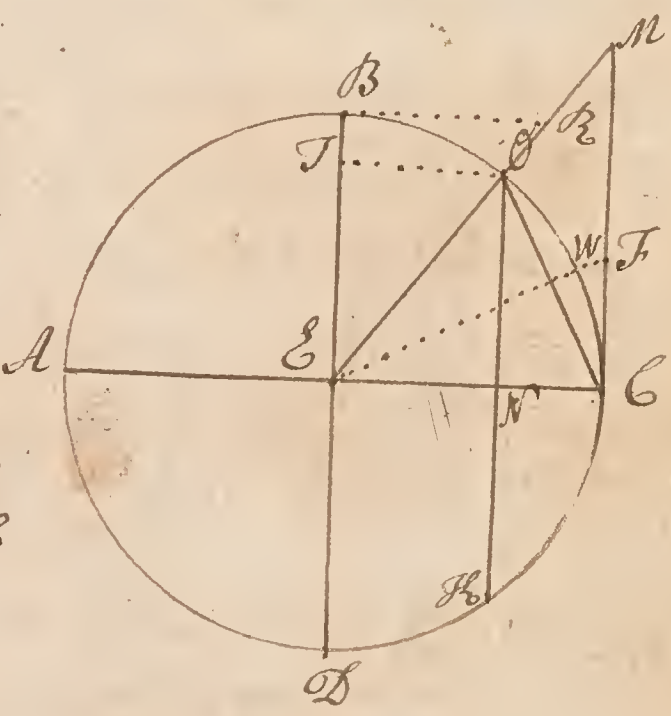
2. The Center of a Circle is that Point in the very midst thereof, as at E, from which all right Lines (called Radius) drawn to the Circumference are equal to one another, as E A, E D, E O, E C, E B, are all equal.

3. The Diameter of a Circle is a right Line drawn from one Side of the Circle to pass through the Center to the other side thereof, dividing y Circle in two Equal Parts, as A C & B D.

4. The Semidiameter, or Radius of a Circle, is just an half of the Diami=ter, being contained between the Center & the Circumference, as E A, E B, E O, E C, E D.

5. A Semicircle is Half the Circumference of a whole Circle, being limited by the Diamiter, as A B C and A D C.

6. A Quadrant is the fourth part of the Circumference of a whole Circle, or half of a Semicircle, as is limited by the two Diamiters, A C & B D, crossing each other at right Angles in the Center, as the Arches A B & B C, C D, D A — each being a Quadrant.



7. An Arch of a Circle is some part of the Circumference limited by two points called the terms, or Extremities thereof, as the Arches A O, B O, O C.

8. The Circumference of every Circle is supposed to be divided into 360 equal parts called Degrees, each Degree subdivided into 60 equal parts called Minuts, and again each De=gree into 60 equal parts called Secones, and so on, this being called the Sex=agesimal Division.

9. A Semicircle contains a 180 Degres, & a Quadrant 90 Degrees.

10. The measure of an Angle is an Arch of a Circle intercepted between y two sides containing the Angle, being described on the Angular point as Center, one as many Degrees as the Arch contains, so much is the Angle; So the Measure of the right Angles A E B and B E C & c is always 90 Degrees or a Quadrant.

11. An Acute Angle, as B E O, is always less, & an Obtuse Angle, as A E O, greater than a right Angle.

12. The Compliment of an Arch or Angle to a Quadrant is so much as

It

It wants of 90 Degrees, as the Arches B O & O C, being both 90 Degrees, are therefor the Compliment of each other to 90 Degrees: But the Compliment of an Arch or Angle to a semicircle is so much as it wants of 180 Degrees, as the Arches A O & O C are the Compliment of each other to 180 Degrees, and both together equal to 180 Degrees.

Now, for as much as the Ratio or Proportion of Arches one to another, as also of an Arch to a right line, is yet unknown; And because the Angles of plain Triangles, and both the Angles & sides of Spherical, are measured by the Arches of a Circle: Therefor the Proportion of all parts of a Triangle one to another cannot be determined, in order to their Calculation, unless these Arches be first reduced to right Lines & the Length of each designe according to an Assigned Radius.

The right Lines of a Circle Applyed to the Measuring of Arches & Angles are Chords, Sines, Tangents, Semi-Tangents & Secants. Such as are now used generally in Calculation of Triangles are Sines, Tangents, Secants and Sometimes Versed Sines.

1. The Chord, or Subtence, of an Arch or Angle is a right Line drawn within a Circle, dividing the Circumference into two parts, and is a Chord to them both. So O K is a Chord of the Arch O C K and also the Arch A O K the Compliment of O C K to 360 Degrees; likwise O C is a Chord of the Arch O W C or Angle O E C; as also of the Arch O A C which is the Compliment of O W C to 360 Deg.; the greatest Chord is A C or B D the Diameter of the Circle, and is the Chord of half the Circumference.

2. A Sine is either right or versed; the right Sine of an Arch or Angle is a right Line drawn within a Semicircle from one end or Term of an Arch perpendicular to the Diameter, and is a Sine to two Arches both equal to a Semicircle, and therefor are the Compliments to each other to 180 Degrees; As O N is the Sine of the Arch O C (or of the Angle O E C) and also of the Arch O B A (or the Angle O E A) the Compliment of O C to 180 Degrees. Or, the Sine of an Arch is half the Chord of twice that Arch; thus, O N the Sine of the Arch O W C is half of O K the Chord of the double Arch O C K. The greates Sine

Is E B, the Radius or Semidiameter of the Circle, and is called the whole Sine being the sign of a Quadrant or 90 Degrees.

3. A Verfed Sine is that part of the Diameter contained betwen the right Sine of an Arch and the Circumference. Thus, N C is the verfed Sine of the Arch O C or K C, and A N the verfed Sine of the Arch O B A or K D A.

4. The Tangent of an Arch or Angle is a right Line perpendicular to the end of the Diameter, and touching the Circle without, being limited by a right Line proceeding from the Center by the end or Term of the Arch. Thus, C M is a Tangent of the Arch C O (or of the Angle O E C) as likewife of the Arch O B A (or the Angle O E A) the Compliment of O C to 180 Degrees.

5. The Secant of an Arch or Angle is a right Line drawn from y Center of the Circle, cutting the Circumference in one of the Extremities of the Arch, and continued till it meet with the Tangent of the same Arch. Thus, E M is a Secant of the Arch O C (or of the Angle O E C) and alfo of the Arch O B A (or the Angle O E A) the Compliment thereof to 180°.

6. A Semi-Tangent is the Tangent of half an Arch or Angle, and not half the whole Tangent of an Arch. Thus, the Semi-Tangent of y Arch O C is C F (the whole Tangent of C W which is half the Arch O C) and not half of C M the whole Tangent of the Arch O C.

7. The Co-Sine of an Arch or Angle lefs than Quadrant is the Sine of that Arches Complement to 90 Degrees. The like underftand of the Co-Tangent & Co Secant. Thus, I O is the Co-Sine, B R the Co-Tangent and E R the Co-secant of the Arch C W O, being alfo the Sine, Tangent & Secant of the Arch B O the Compliment of C W O to 90 Degrees.

8. The Co-Sine, Co-Tangent &c of an Arch greater than a Quadrant is the Sine, Tangent &c of the excefs of that Arch above a Quadrant or 90 Degrees. Thus the Co-Sine, Co-Tangent, & Co-secant of the Arch O B A is I O, B R and E R.

By the preceeding Definitions 'tis evident, that a Chord is common to two Arches, which together make a whole Circle, & therefor the Com-

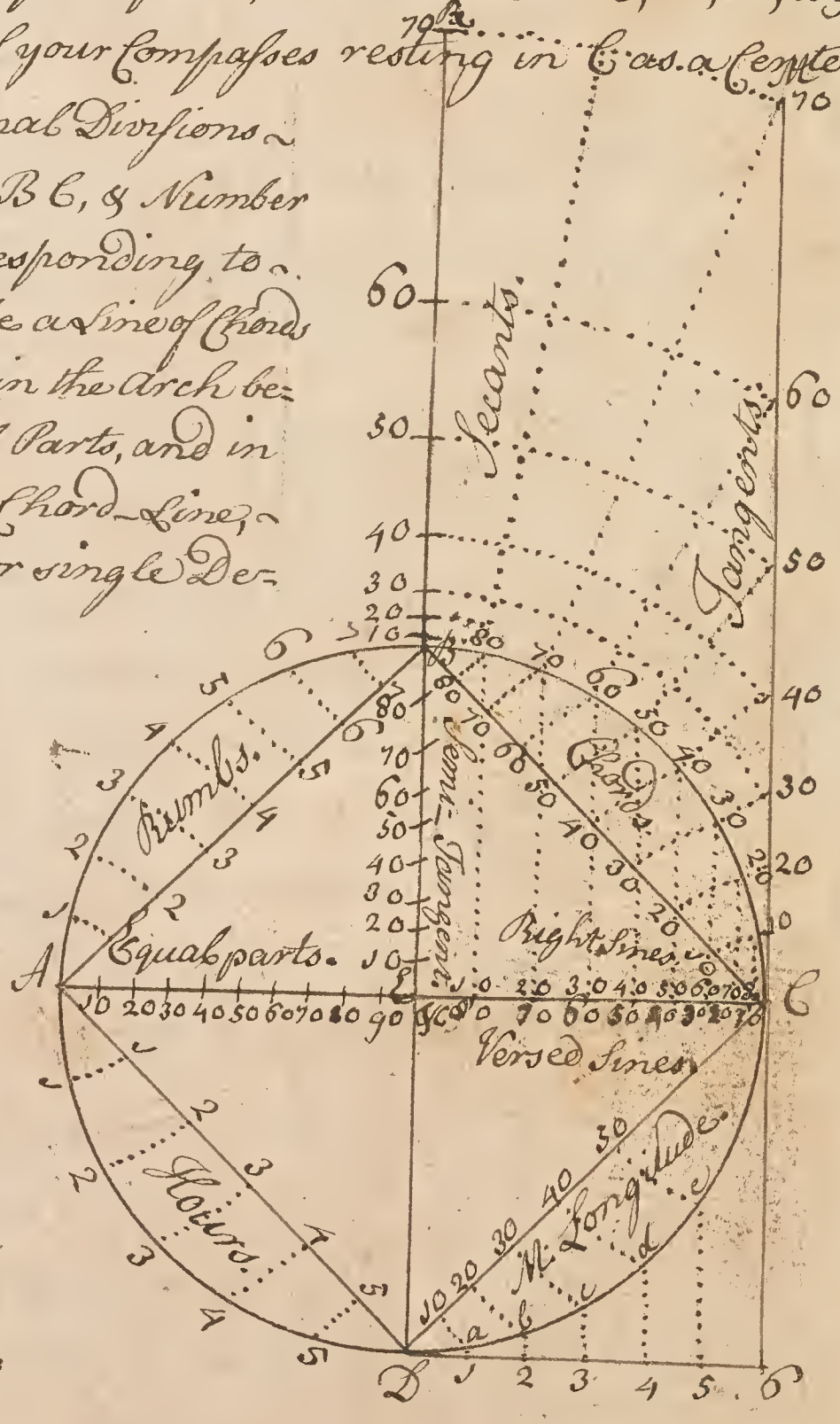
Compliments of each other to 360 Degrees: And likewise a Sine, Tang=
=gent, & Secant is common to two Arches, which together are equal to a Se=
=mi-Circle, and are therefor the Compliments of each other to 180 Degrees.

The Construction, or making, of the Natural Sines, Tangents, and Secants &c. as they are placed on y^e Mariners plain Scale.

1. Discribe a Circle, as A B C D, of a convenient Radius, which di=
=vid into four Quadrants by two Diameters A C & B D crossing each other at right Angles in the Center.

2. For the Line of Chords, draw the Chord Line of the Quadrant B C, and divide the Arch thereof into 9 equal parts, which mark w^t 10, 20, 30, to 90 from C to B; then with one Foot of your Compasses resting in C as a Center, with the other transfer the several Divisions from the Arch to the right line B C, & Number it also with 10, 20, 30, to 90 corresponding to those in the Arch; So shall B C be a Line of Chords to every 10th Degree, and every 10 in the Arch be=
=ing again divided into 10 equal Parts, and in like manner transfered to the Chord Line, will give all the intermediate or single De=
grees; But it may suffice, if e=
=very 10 in the right Line be di=
=vided into 10 equal Parts.

3. For the Line of right Sines, from the Points of the several di=
=visions 10, 20, 30 &c in the Arch C B draw Parellels to C B cut=
=ting C E; so shall C E be divid=
=ed into a Line of right Sines w^t Number with 10, 20, 30 &c to 90 fm C to E: The single Degrees may be had by dividing every 10 in the Arch into 10 equal Parts, & draw=
=ing the Parellels as before; But if every 10 in y^e right Line C E be divided into 10 equal Parts, it will suffice without any sensible Error.



4. If those several divisions in y^e right Line C E be numbred with 10, 20, 30 &c from C to E, it will be a Line of Versed Sines to 90 Degrees, &

May after the same maner be continued from E to A (the other half of the Diameter) to 180 Degrees.

5. For the Line of Tangents, on one end of the Diameter, as at C, raise the Perpendicular C M to touch the Circle without, which produce a sufficient length, and by the Age of a Ruler laid from the Center E to the se: =veral divisions 10, 20, 30 &c in the Arch of the Quadrant C B divide the line C M into these several parts 10, 20, 30. &c coresponding to the divisions on the Arch; hereby is C M uneqully divided, and becoms a line of whole Tangents.

6. For the Line of Secants, set one Foot of the Compasses in the Center E, and with the other transfer these several extents from the Graduati: =ons in the Line C M to the right line E R, which mark also with 10, 20, 30, &c coresponding to the Graduations in the Line C M; so shall E R be a Line of Secants. The single Degrees of the Lines of Tangents & Secants ought to be Graduated, by the same reason, from the single De: =grees of the Arch, as every 10 is, especially those above 40 Degrees; for then they increase fast, and are also very unequal.

7. For the Line of Semi-Tangents, by the edge of a Ruler laid from A to the several divisions 10, 20, 30, &c to 90 in the Quadrant C D divide the Line E B into the several parts 10, 20, 30, &c coresponding with these in the Arch; so shall E B becom a Line of Semi-Tangents. The single De: =grees may be divided like as the Tens, or if every 10 in the Line E B be divided equally into Tens, it may serve.

8. For the Line of Equal Parts there needs no Directions.

9. For the Line of Rumbs, divide the Arch of the Quadrant A B into 8 equal parts, then, one point of the Compasses resting in A, with y other transfer the several extents from these divisions to the right Line A B, which number, 1, 2, 3, &c to 8 from a to B; So is A B a Line of Rumbs, or the points of the Comas.

10. For the Line of Hours divide the Arch of the Quadrant A D into 6 equal parts and from A as Center transfer them to the right Line A D which will be a Line of Hours to be used with the aforsaid Line of Chords.

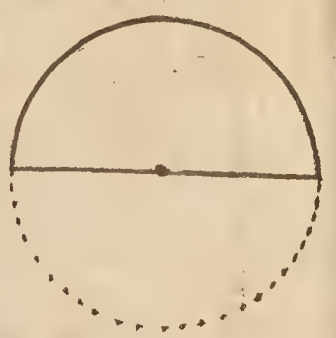
11. For the Line of Longitude draw the right Line D 6 parellel to E C & C 6 parellel to D E So is the Squar D E C 6 constructed Divide the line D 6 into six equal parts & draw the Lines 5 e, 4 d, &c parellel to D E whereby the Arch of the Quadrant C D is divided into 6 unequal parts then placing one Foot of the Compass on C with the other transfer the se:

Several Etents to the points c, d, e, &c in the Arch to the right Line C D So shall C D be an Line of Longitude to every 10 Miles or Minuts & all the intermediate or single parts ought to be divided like as the 10° is by divid= =ing the several parts of the Line D C into 10 equal parts & draving Parel= =lels for each. This Line of Longitude is to be used with y^e Line of Chords afore= =said & serves to find how many Miles or Minuts in any parellel of Latitude al= ters (or answers to) a Degree of Longitude in the Equinoctial.

N: B: That those Lines being all made to one radius, they may be used jointly one with another & not otherwise; and if they all be made to coresponed with the same radius then the Chord of 60 Degrees the Tangent of 45 Degrees the Semi-Tangent & Line of 90 are all equal to one another & also equal to the Semidiameter or Radius: That, if the Radius be di= =vided into any number of Equal parts but most conveniently 10, 100 &c and if a line of Equal parts be made coresponding therewith of a sufficient length you may thereby measure the Chord, Sine, Tangent &c of any Arch & find how many of these parts of the Radius are contained therein but not being Acurate enough for Arithmetickall Calculations it is therefor absolutly necessary that those right Lines (especialy such as are commonly used in the Calculation of Trianeles) be determined to greater Accuracy in Numbers to an assigned Radius the Tables whereof are called the Cannon of Natural Sines Tangents & Secants.

The Division of a Circumference in concordancy with 12.

1. The Circle being a round Figure representeth a Cy= =pher, or O, the Center of which doth denot the Unit, or 1, from whence infinite deductions are made unto multi= =tude, as from the Center infinite Lines may be draven to the Circumference; & by cutting the whole Circle into parts shall be infinite Sections beneath the whole, as from 1 brozen into pieces arise infinite Fractions: And thus the Diameter terminating the Circumference represents one half, or Semicircle.



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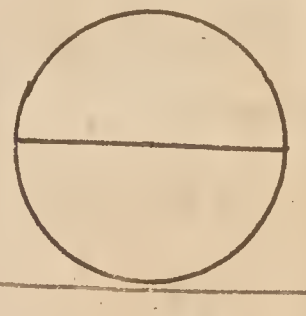
2. The Diameter drawn through the Center to the Circumference divideth the Circle into two equegual parts.



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3. A Perpendicular, falling from the Circumference on the Diameter in the Center, divideth the Circumfe= =rence into 3 parts of which the lesser 2 are equal to y^e 3.

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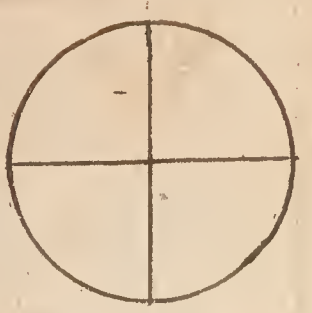
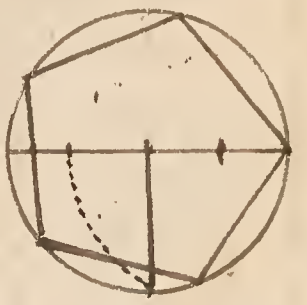
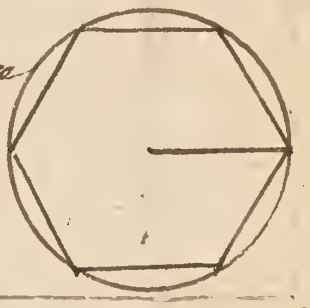
4. Two Diameters, crossing each other at right Angles in the Center, divide the Circle in four equal parts called Quadrants.



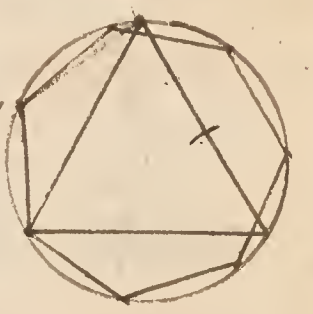
5. From the Half of the Semidiameter to the half of an Arch drawn from the Circumference to the touch of the other Semidiameter, the distance of the touch to the first half gives a 5th of the Circumference, or very neer it.



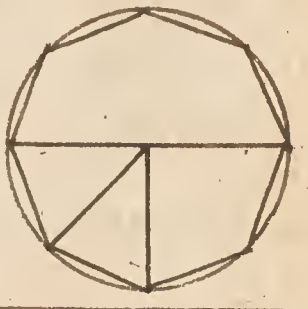
6. The Semidiameter applyed to the Circumferen is little less than a Sixth part of it.



7. Half of one of the Sides of the greatest Equilateral Triangle inscribed in a Circle shall equall the 7th parts of a Circumference pretty exactly.

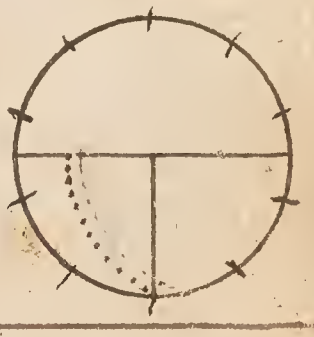


8. The Quadrant equally bisected shall divide the Circumference into eight equal parts.



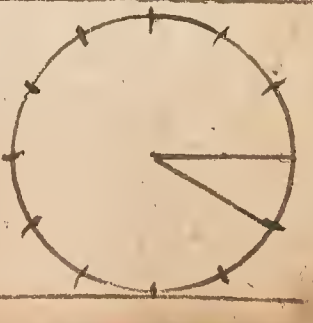
9. Two thirds of the Diameter parteth y^d Perimeter or Circumference in nine equal parts or divisions.

10. From half of the Semidiameter to the half of an Arch drawn from the Circumference to the touch of the other Semidiameter, the distance of the touch to the Center will give nigh the tenth.



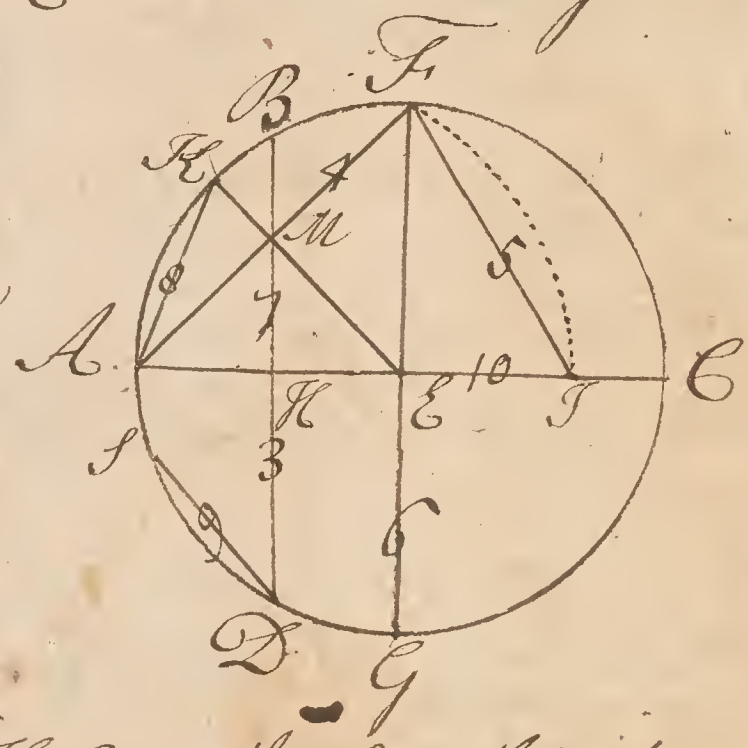
11. The length of a Line from the point where two Circles cut each other to the Semidiameter may be taken for the Eleventh parts of the perimeter or Circumference.

12. The third parts of a Quadrant is the twelfth part of a Circle & the Sixth of a Semicircle.



To Divide a Circle into any Number of Equal Parts not exceeding Ten.

First, Describe any Circle as A F C G, and draw two Diameters A C & F G crossing each other at right Angles in the Center E.



2. Make A B and A D equal to E F, and join B D; so is B D the third part of the Circle.

3. Join A and F; so will A F be the fourth part.

4. Upon H, and distance H F, describe the Arch F I, and join F I, which F I is the fifth part.

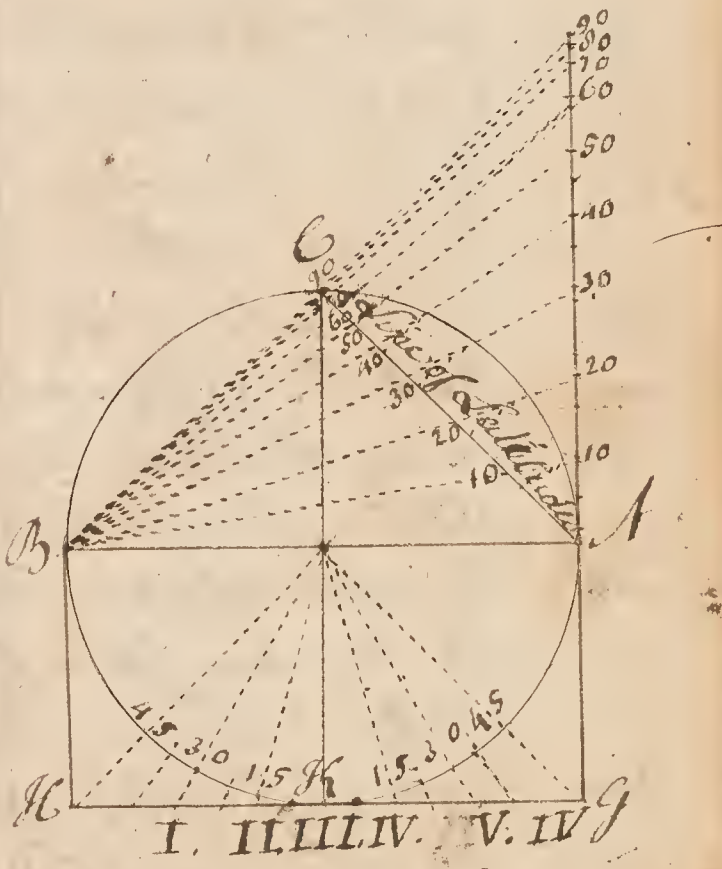
5. E F, E G, A E, E C, either of them, are the sixth part. 6. H D or H B are the seventh part.

7. Draw a Line from the Center E through the point M, extending it to K; join K A, which will be eight part.

8. Divide the Arch D A B into three equal parts at S, and join S D, which will be the ninth part. 9. E I is the Tenth part.

Projection of the Line of Latitudes & Hours.

Upon the end A, of the Diameter of the Circle erect a Line of ~~Latitudes~~ Lines at right Angles, of the Length of the Diameter; then from the Point B, the other end of the Diameter, draw right Lines to each Degree of that Line of Lines, cutting the Quadrant A C. Now having drawn the Chord Line A C, which is to be the Line of Latitudes, set one foot of your Compasses upon the point A and with the other transfer the Intersections made by the Lines drawn from B, on the Quadrant, to the Chord Line A C, by means of which it will be divided into a Line of Latitudes. Or the Line of Latitudes may be made by this Canon, Viz. As Radius is to the Chord of 90 Degrees, So is the Tangent of any Degree, to another Tangent, the Natural Line of whose Arc, taken from a Diagonal Scale of Equal parts, will give the Division, for that Degree, on the Line of Latitudes, and so for any other Degree.



Hour Scale.

Again; To graduate the Line of Hours, Draw the Tangent G H equal to the Diameter A B, and parallel thereto, then divide each of the Arcs of half the Quadrants A K, B K, into three parts, for the Degrees of every Hour from 12 to 6, which must again be each subdivided into Halfs, Quarters, &c. then if thro' each of the aforesaid Divisions & subdivisions, Lines be drawn from the Center; cutting the Tangent Line G H, they will divide the said Line into a Line of Hours.

Use of the Line of Latitudes and Hours.

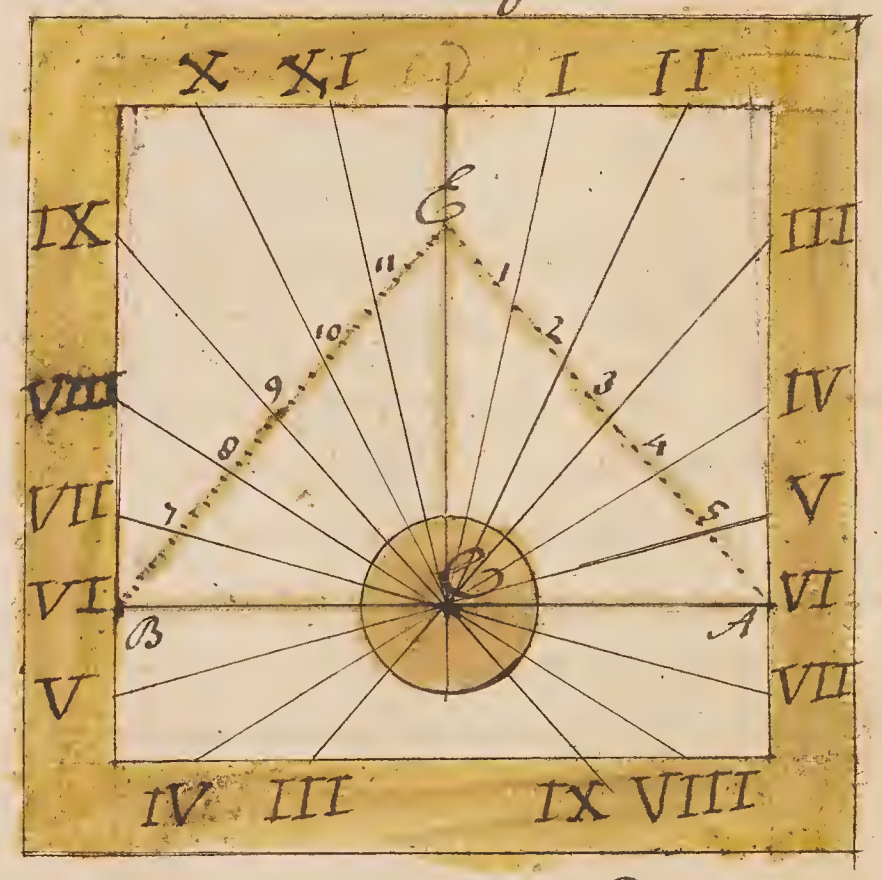
These Lines are conjointly used, in readily pricking the Hour Lines from the Substile, in an Isosceles Triangle on any kind of upright Dials, having Centers in any

given

Given Latitude; that is by means of them there will be a Proportion worked, viz. As Radius Is to the Sine of the Styles Height, So is the Tangent of the Hours or Angle at the Pole, To the Tangent of the Hours distance from 12 for the Hour Arc.

Now suppose the Hour Lines are to be pricked down upon an Horizontall Dial for the Latitude of 57° 10'.

Draw C E for the Hour Line of 12, and cross it at right Angles with A B, Then out of the Scale of Latitudes set off C A & C B each equal to the Latitude viz 57° 10' or the Styles height. Then take the whole Scale of 6 Hours, and set it from A to E, and from B to E, dividing those two Lines A E & B E with the Compasses accordingly, as you see in the figure:



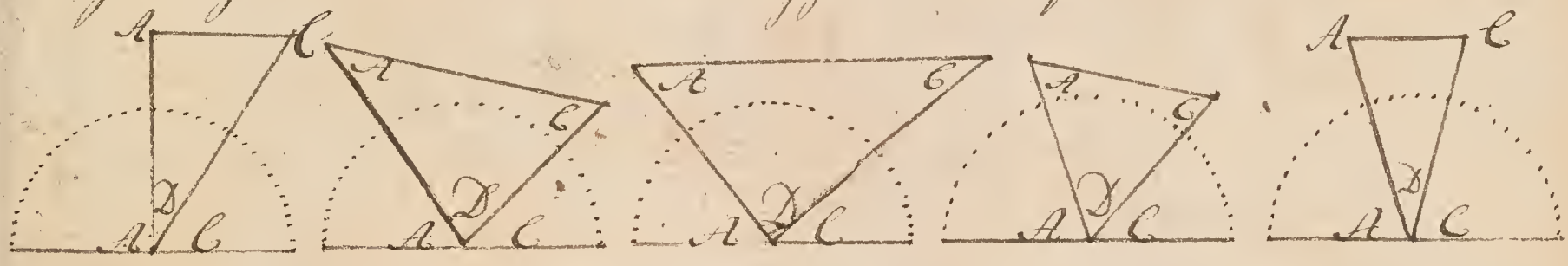
Then Lines drawn from C, the Center of the Dial, through those points 1, 2, 3, 4, 5, and 11, 10, 9, 8, 7 & 6 shall be the true Hour Lines.

The Properties of Plain Triangles.

In every Triangle the greatest side is opposite to the greatest Angle; and equal sides make equal Angles, whence all the Angles of an Equilateral Triangle, and the Angles at the Base of an Isosceles Triangle are equal.

In every Triangle, right Angled or Oblique, the three Angles taken together are equal to 180 Degrees; therefor, if an Acute Angle in a right Angled Triangle be given, the other Acute Angle is it's Complement to 90 Degrees, & is thus proved;

Right angled. Scalene. Amblygonium. Equilateral. Isosceles.



In all these Triangles the Angle A without is equal to the Angle A within the Semicircle, the Angle C without is equal to the Angle C within, and the Angle D is contained already in the Semicircle; therefor any three Angles of any Triangle contain 180 Degrees.

The Arches are the measures of their Opposite Angles; as, the Arch G H is the measure of the right Angle A; the Arch F E is the measure of the Angle at C; & I K is measure of the Angle at B. These Arches are Degrees & minutes of the Firmament, & the sides are the Length of any kind of Measure upon Sand or Ca.

The side B C is called the Hypothenuse, A C the Perpendicular; & B A the Base. In every right Angled Triangle the Length of the Chord of 60 upon one side of the said Triangle may be supposed Radius; Then will the other sides be either Sines, Tangents, or Secants. Thus, if B C is supposed Radius, then are the other two sides B A & A C the Sines of their opposite Angles. If A C is supposed Radius, then is B A the Tangent of the Arch F E, and the side B C the Secant of the Angle C. If B A is supposed Radius, then will A C be the Tangent of the Angle B, & B C be the Secant of the Angle B, Consequently B A is the Tangent & B C the Co-Secant of the Angle B.

Theorem.

Theorem. In all plain Triangles the sides are proportional to the Sines of their opposite Angles; That is, As the Arch of H is to B C the Side, so is the Arch F E to the side B A, and the Arch I K opposite to the Angle B to the Length of the side A C. In the Canon the Hypothenuse is the supposed Radius.

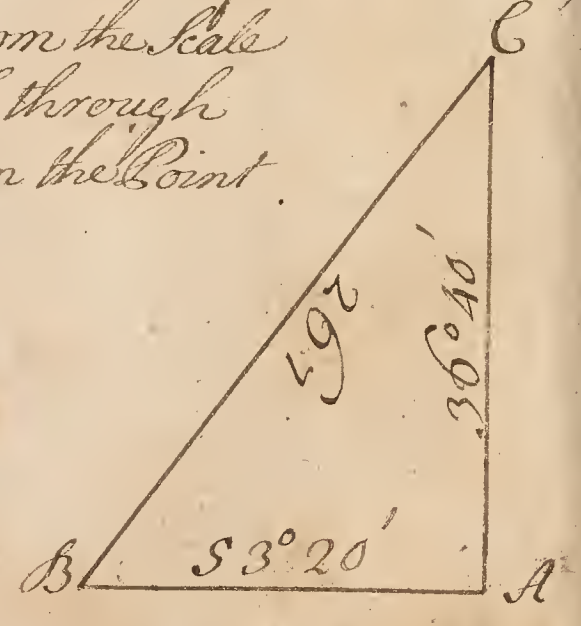
And since the Arches are measures of their opposite Angles, we refer the Arches to the Angles, & do not draw Arches in every Triangle, nor mention the Arches at all.

Of Plain Trigonometry Rectangular.

Case 1. Given the Hypothenuse B C and the Angle C, to find the Perpendicular C A & the Base B A. Ex: Given the Oblique side of a Hill B C measured to be 267 Paces and the Angle taken to be 36° 40', to find the Perpendicular Height of the Hill C A and how far may be digged from the Foot of the Hill at B to be just under the Top at C.

Geometrical Construction.

Draw C A of any Length, set the Chord of 60° in C & make an Arch upon which set on the given Angle, make the Arch of that extent; then the Length of the Hypothenuse taken from the Scale of Equal Parts and the Length drawen from C through the mark to B, then let the Line B A fall from the Point B and it is done.

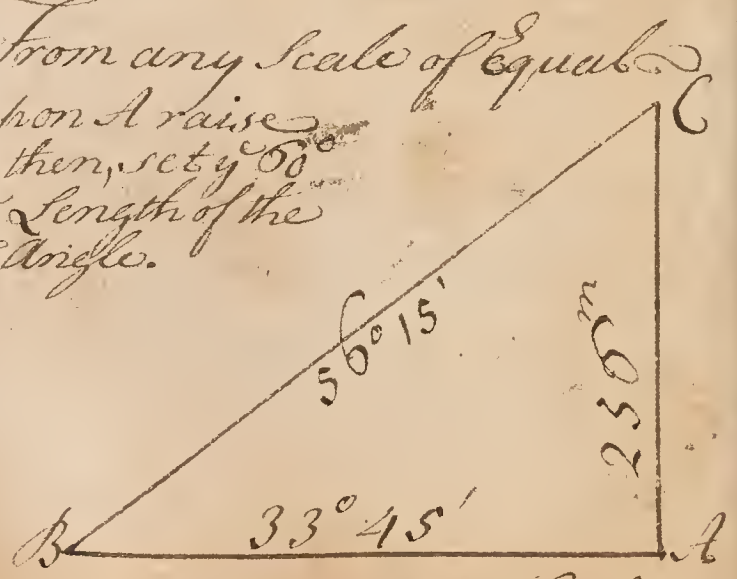


As Radius A C of 90° 10.000000
To the Hypothenuse B C 267 ..... 2.426511
So is the Sine Angle C 36° 40' 9.776090
To B A 12.202601
And so the Sine Angle B 53° 20' 9.904241
To the Perpendicular C A 2142 ..... 12.330752

Case 2. The Angle C & Perpendicular given, to find the Length of the Hypothenuse B C and Base B A. Ex: Given the Angle C 56° 15 and Perpendicular 2.56 m to find B C & B A.

Geometrical Construction.

From any Scale of Equal Parts lay down the Perpendicular C A, upon A raise a Line at right Angles of Length at Pleasure then, set the 60° on C a Ruler laid to C & that mark Draw the Length of the Hypothenuse where it meets the Base frames the Angle.

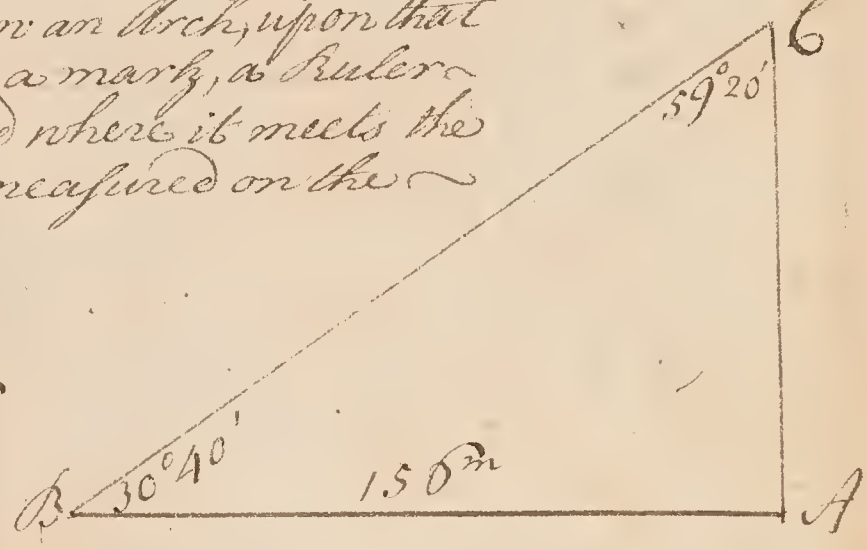


As the Sine of the Angle B 33° 45'
To the Perpendicular C A 2.56 m
So is the Sine of C 56° 15'
To the Base B A 3.83¼
And so is Radius 90°
To the Hypothenuse B C 4.62 a. 9.

Case

Case 3. Given the Angle B & Base, B A to find ye Hypoth: B C & Perpen: C A. Ex: Given the Angle B 36° 40' & Base B A 156^m, to find the Length of B C & C A.

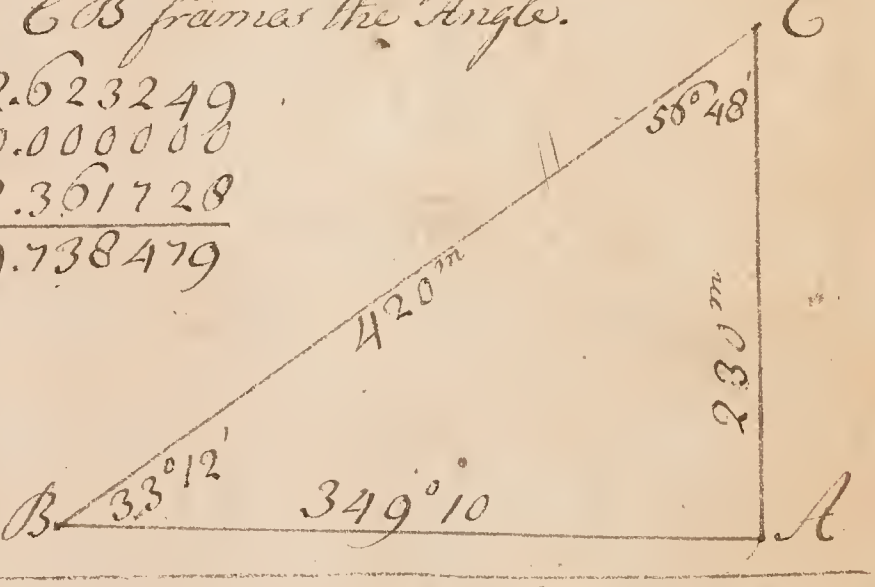
Geometrical Construction. From any Scale of Equal Parts lay down this Base B A, raise a Line at right Angles of Length at Pleasure, then the 60° rest on B, draw an Arch, upon that Arch set on the given Angle & make a mark, a Ruler laid to B & the Mark draw a Line, and where it meets the Perpendicular frames the Angle measured on the same Scale.



As the Sine of C 59° 20' 9.934574
Is to the Base B A 156^m 2.193125
So is the Sine of y^e Angle B 30° 40' .. 9.707606
11.900731
To the Perpen: C A 92° 5' 1.965157
And so is the Radius 90° 10.000000
To the Hypoth: B C 182° 2.258551

Case 4. Given the Hypoth: & Perpen: to find the Angle and Base. Ex: Given ye Hypoth: B C 420^m & Perpen: A C to find ye Angles & Base B A.

Geometrical Construction. From any Scale of equal Parts lay down C A, upon A raise a Line at right Angles of Length at pleasure, from the same Scale take the Length of the Hypothenuse C B and set one Foot on C, and where the other Foot crosses the Base B A make a Mark, a Ruler laid to C and the Mark Draw the Hypothenuse C B frames the Angle.

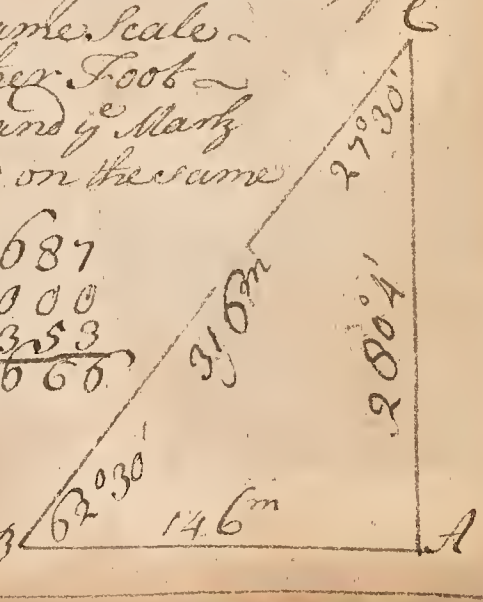


As the Hypoth: B C 420^m 2.623249
Is to Radius 90° ..... C 10.000000
So is the Perpendicular A 230^m 2.361728
To the Sine Angle B 33° 12' 9.738479

As the Radius 90° 10.000000
Is to the Hypoth: B C 420^m 2.623249
So is the Sine Angle C 56° 48' .. 9.919846
To the Base B A 349° 10' 12.543906

Case 5. Given ye Hypoth: & Base, to find ye Angle & Perpendicular. Ex: Given the Hypoth: B C 316^m ye Base B A 146^m, to find ye Angle & Perpendicular C A.

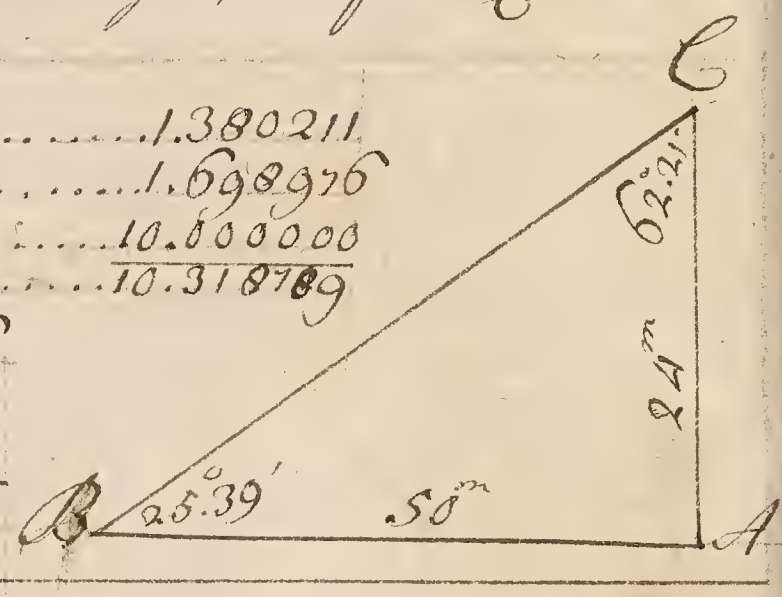
Geo: Construction. From any Scale of Equal Parts lay down B A, upon A raise a Perpendicular of Length at pleasure from the same Scale take of the Length of ~~the~~ C B to one Foot on B & when the other Foot crosses the Perpendicular make a Mark, a Ruler laid to B and y^e Mark draws the Hypothenuse B C frames the Angle to be measured on the same Scale.



As the Hypothenuse B C 316^m 2.499687
Is to Radius 90° 10.000000
So is the Base B A 146^m 2.164353
To the sine of the Angle C 27° 30' 9.664660
As the Radius 90° 10.000000
Is to the Hypothenuse B C 316^m 2.499687
So is the Sine of the Angle B 62° 30' 9.947929
To the Perpendicular C A 280° 4' 12.447616

Case 6. Given the Perpen: & Base, to find the Angle & Hypath:. Ex: Given the Perpendicular C A 24^m & Base B A 50^m, to find the Angles & Hypoth: B C.

Geo: Construction. From any Scale of equal Parts lay down C A the Perpendicular & B A the Base, at right Angles, then from C & B draw the Hypothenuse C B and it is done.



As the Perpendicular C A 24^m 1.380211
Is to the Base B A 50^m 1.698976
So is the Tangent Radius 45° 10.000000
To the Tangent of the Angle C 10.318765

As the Sine of the Angle C 25°.39′ 9.636360
Is to the Perpendicular 24^m 1.380211
So is Radius 90° 10.000000
To the Hypoth: C B 55^m 1.743851

Plain Trigonometry Obliquiangular.

The Properties of plain Oblique Triangles.

I. Oblique Angles hath one Angle Obtuse, or more than 90°; the other Angles are Accute, or each less than 90 Degrees.

II. If an Angle have two sides equal 'tis an Isosceles, its Angles at the Base are Equal, and all its three Angles are Accute, each less than 90°.

III. If all the three sides are Equal its called an Equilateral Triangle, all its three Angles are equal to one another and Accute.

IV. All the three Angles of any Triangle is equal to 180°; therefor if any be known & other two is known in one Sum by taking the given ~~the given~~ Angles from 180°; & if two Angles, be given, take their Sum from 180° remains ye 3^d Angle.

V. In an Isosceles Triangle one Angle given, the rest is also known; for if the Angle contained by the Equal sides be given, then half the Complement to 180° is equal to each of the other two Angles. If one of the Adjacent Angles be given, the other may be known being Equal to it, and the remaining Angle is equal to the Complement of their Sum to 180 Degrees.

VI. In Oblique Triangles there is always three things given either two sides, and one Angle, or, Vice versa, two Angles & one side, to find the other sides and Angles.

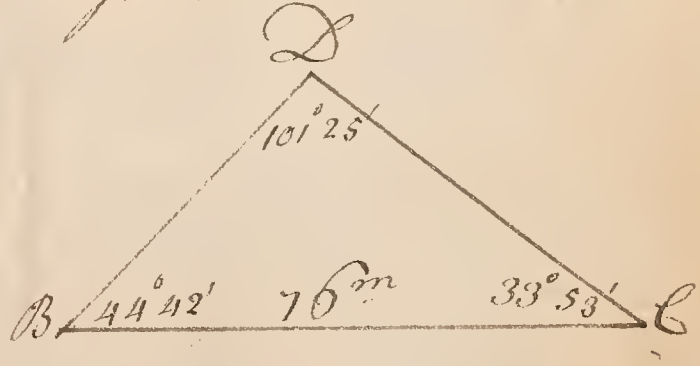
Theorem I.

In all Oblique Plain Triangles the sides are proportional to the Sines of their opposite Angles or as the Sine of an Angle is to its opposide so is ye Sine of the other Angle to their opposite side.

Case 1. Prob: The Angles and one side given to find the other sides. Ex: Given B D C 101°25', C B D 44°42' & ye side B C 76^m requires ye Length of B D & D C

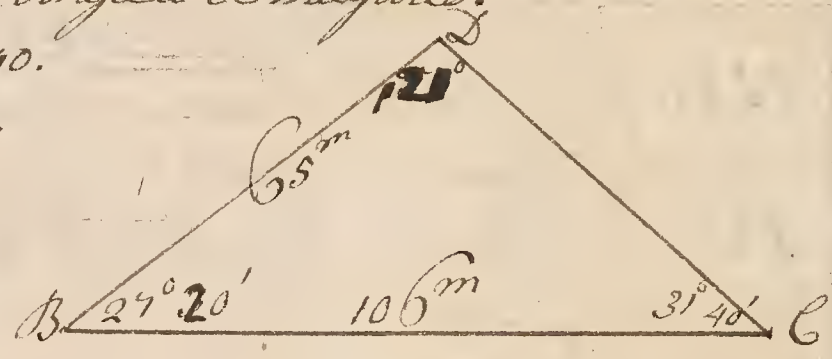
Geo: Construction. From any Scale of Equal Parts lay down B C upon B draw the 60° upon that Arch set the given Angle B make a Mark and draw a Line to Length at pleasure then set the 60° in C upon this Arch set on the Angle C make a Mark a Ruler laid to C & the Mark draw the Line B C compleat the Angle to be measured on the same Scale.

D: M	
101.25	As the Sine of y^e Angle D 78°35.
	Is to the side B C 76^m.
44.42	
146.07	So is the Sine of the Angle B 44°42'.
	To the side D C 54°5'...
180.00	
33.53	And so is the Sine of C 33°53'.
	To the Side B D 43^m3.
180.00	
101.25	
78.25	



Cases 2 & 3. Prob: Two sides & the Angles opposite to one of them to find the other opposite Angle & 3 Side. Ex: Given B C 106^{m} B D 65^{m} B C D 31.40' to find B D C and Side C D.

Geo: Construction. Make B C equal to 106^{m} upon C draw the 60° upon that Arch set on the given Angle C make a Mark, a Ruler laid to C and the Mark Draw a line then make the length of B D set one in B & where the other Foot marks the line frames the Angle to be measured.



As the Side B D 65^{m} — As the Sine of Angle C 31°40.
Is to the Angle C 31.40 — Is to the Side B D 65^{m}...
So is B C .... 106.183 — So is the Angle B 27°30.
To the Angle D .... 121° — To the Side D C 57^{m}....

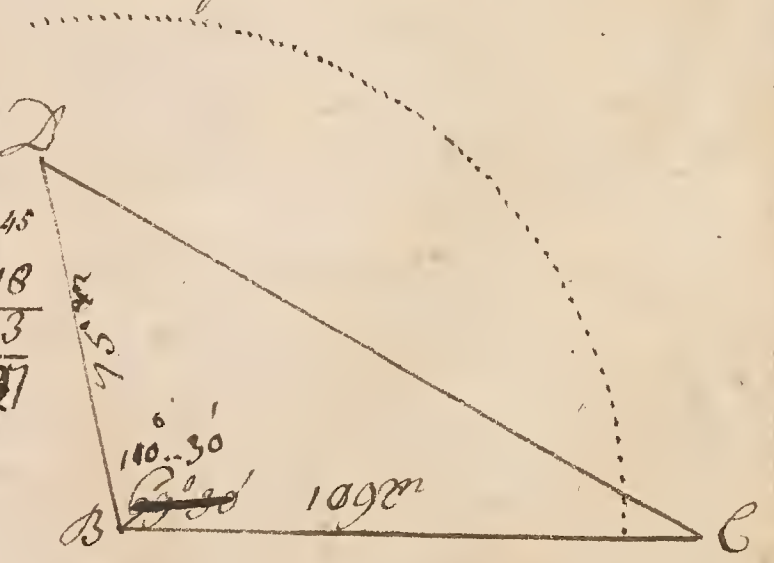
Obtuse Angle 31.40
1.52.40
180.00
Angle B 27.20

Theorem II.

As the Sum of the given sides: is to their Difference:: so is the Tangent of half the Sum of the Angles opposite to these sides: to the Tangent of half the Difference of these Angles the which added to half the Sum gives the greater Angle & subtracted gives the Lesser.

Cases 4 & 5. Prob: Two sides & the contained Angle given to find the other Angles & their sides. Ex: Given B C 109^{m} B D 75^{m} C B D 110°30' requires the other Angles & Sides C D.

Geo: Construction. Make B C equal 109^{m} upon B draw the 60° upon that Arch set on the given Angle & make a Mark a Ruler laid to B & the Mark Draw the Extent of B D then to the Extremes of C & D draw the line D C to be measured on that Scale.



B C 109^{m} — 180°.00
B D 75 — 110.30
Sum 184 — ½ 69.20
Diff: 34 — 34.45
As the Sine of Angle D 42.3.
Is to the Side B C 109^{m}
So is the Co-Sine of the Angle B 69.30.
To the Side D C 152.

As the Sum of the Sides .. 184
Is to the Difference 34
So is the Tangent of ½ 34.45
To the Tangent of ½ the Diff. 7.18
Angle of D 12.3
Angle of C 27.21

Theorem III.

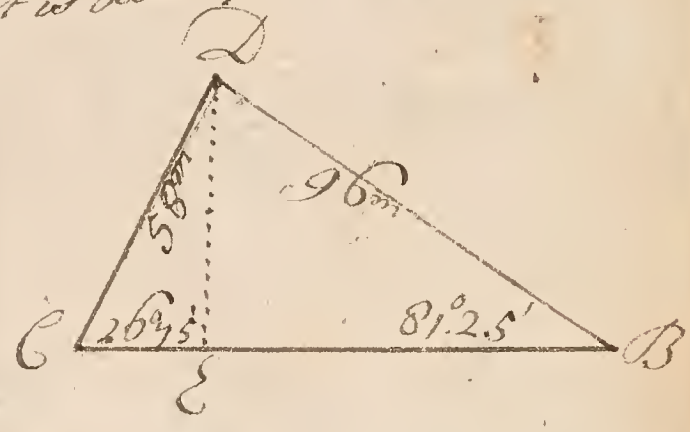
As the Tangents side: is to the Sum of the other two sides:: so is their Difference: to the Difference of the Segments i,e. C E and E B which is made by a perpendicular from D to E then half the Difference added to half the longest Sides the Sum is E B and if subtracted remains C E the Lesser Segment.

Case 6.

Case 5. Prob: The sides given to find the Angles & Segments.

Ex: Given B C 108^m B D 96^m C D 58^m to find the Angles.

Geo: Construction. From any Scale of Equal Parts make B C 108^m then with the Extent of B D set one Foot on B & Sweep an Arch as at D then with the Extent of C D set one foot in C & cross the Arch at D to this points draw the Lines B D & C D & it is done.



D. B. 96
D C. 58
Sum. 184
Diff:... 38

½ of 108 = 54
½ of 54.5 = 27.25
Greater Seg: 81.25
Lesser Seg: 26.75

As Radius 90°
To to C D 58...
So is C E 26.75..
To ye Angle C D E 27.40
taken fm 90° remains
the Angle E C 62.20..

54.5
27.25
54.
81.25
26.75

As C B 108:
To to ye Sum of the sides 154::
So is their Difference 38:
To the Diff of Segments 54.5

As Radius 90°
To to D B 96
So is E B 81.25
To ye Angle E D B 57.
taken from 90 Remains the Angle B 33.

Observations & Dimensions of Land lying in the Parish of _____, in the County of _____ Part of the Estate of _____ December 17th 1753.

Remarks.	Offsets.	Station Lines.	Offsets.	Remarks.
		⊙ 1 in Fowlers Field.		
	B	356° 10′		
Corner of Con		.20	Ag..15	Corner of Fur:
Pasture, Hedge	Ag..80	.40		Heth Field, Hedge
to Con pasture	.10	2.80		to Heath Field.
		3.	.20	
	.18	5.63		
		⊙ 2 in the Lane.		
338° 00 B of Com.				
180 00 semi Circle	B	338° 00′		
518..00				
356..10 last Bear:	V	161° 50		
161..50 = Angle	10	0		
		.20	Ag.17	Hedge to Home
		4.46		Close.
		⊙ 3 in the Lane.		
1° 30′ Bear. of Com:				
180° 00 semi Circle	B.	1° 30′		
181..30 less than 338°	L	203° 30′		
360..00 a whole Cir:	.20	0	.10	
541..30		.41	Ag: .10	Orchard Hedge.
338..00 last Bearing		2.04	Ag: .15	Orchard Pales
203..30 L^te of Field	.35	2.61	.20	Gate into the yard.
Gate into Com pasture.		2.90	.18	Corner of Barn.
Hedge to	.20	3.66	Ag:.24	Calnes Croft
Do/				Hedge.
		4.35		

Remarks	Offsets	Station Lines	Offsets	Remarks
		⊙ 4 in the Lane		
	B	349° 30′		
	>	168° 00′		
	As:.20	.90		
	.13	1.40		
		2.20	.0	on Stock Home
Gate into Fair	.16	5.		Croft Hedge.
Field Hedge to Field.		6.26		
		⊙ 5 in the Lane		
	B.	13° 30′		
	>	204 20		
	.10	0	.20	
		.64	.12	
	.35	1.52		
	.30	2.36	.10	
		⊙ 6 in the Lane		
	B	93° 30′		
	>	259 40		
Corner of Home	0	.10 into		
Croft.	Into Home Croft.			
	.06	2.70		
	.03	5.		
	.40	7.50		
		⊙ 7 in Home Croft.		
	B.	193° 30′		
	>	260° 00		
Hedge to Park.	.23	0		
	.60	3.35		
	.45	6.20		
	As. 20	6.68		
		6.80		
	/	⊙ 8 in Home Croft		
	B	229° 00′		
	[illegible]	215 30		
Hedge to Home Croft.	.10	0		
	.10	2.68		

Remarks	Offsets	Stations	Lines	Offsets	Remarks
		O 9 in Home Croft.			
	B	268°. 30'			
	L	219 20			
Corner	30	.22			
Hedge to Home Croft.		3.		20	Close Home Croft here.
Hedge to Lane, in Corner next to Calves Croft.					
		O 9 return			
	B	192°00			
	L	143° 00			
		20 in tus			
		Into Home Close			
		.90		.20	Calves Croft Hedge.
		2.20		.20	Garden pales.
		3.50		.20	Corner of Orchard Field.
		3.61			
		O 10 in Home Close			
	B.	260° 40'			
	L	252 40			
		2.05			O on Orchard Hedge.
		2.50			20 Close here.
		2.55			
Out lines of Orchard, Garden, &c. Close on Hedge next the Lane.					
		O 8 return.			
	B	105°00'			
	L	91° 30'			
		.19 in tus.			
		Into Home Close.			
Hedge to Wood	Corners	.24			
	.37	3.53			
	.26	4.65			
		O 11 in Home Close			
	B	193°30'			
	L	268 30			
	.60	1.30			
Hedge to home Close	Ag: .61	4.76			
Corner	.18	7.27			
		O 12 in Home Close			
	B	259°00			
	L	246.00			
	Ag: .28	.65			
	.46	2.68			
		6.67	Close here		
Close Home Close on Hedge to Lane next Heath Field.					

Remarks.	Offset.	Station.	Lines.	Offset.	Remarks.
		⊙12 rel:			
	B	169° 20′			
	⊃	176 00			
		.20 intus			
		into Crabtree Close			
		.60		.55	Corner Hedge N. Heath Field.
		6.12		12	For Corner.
		6.18 int:			
		into Fowlers Field.			
		6.42			
		⊙13 in Fowlers Field.			
	B	262° 40′			
	L^e	253 20			
		.10		.25	
		5.10		.20	Close here
		5.30 reaches first Station.			
Heath Field. Clover on Corner of Hedge next Vane.					
		⊙13 return			
	B	103° 00′			
	L^e	94 00			
Touch on Hedge	0	1.35			
in Crab Tree Close.	17	3.10			
		⊙14 in Fowlers Field.			
	B	69° 00′			
	L^e	146 00			
	.03	3.20			
	.26	5.45			
		6.18			
		⊙15 in Fowlers Field.			
	B	5° 00′			
	L^e	116 00			
	.15	.60			
		1.66 int:			
		Into a Common.			
Hedge to Crab	1.20	3.37			
tree Close.	.16	5.63			
		6.45			

Remarks	Offset.	Station Links	Offset	Remarks.
		0 16 in Common		
	Bs	276° 35'		
	Lks	91.35		
		.16 int:		
	Into Crabtree Close			
		.22	30	Hedge to Wood
		7.10		Close here
Close Crabtree Close on Corner next home Close & Wood.				
		0 16 return.		
	Bs.	10° 20'		
	>	105. 20		
	.22	2.20		
	.60	3.86		
	.69	4.34		
A Gate into the Wood.	.50	6.11		
	.10	9.30		
	.32	11.10		
	.56	12.68		
	1.42	13.53		
		15.52		
		0 17 in the Common		
	Bs	264° 30'		
	Lks	74 10		
	1.28	2.25		
		3.16 int:		
	Into Henry Hunter's Lane.			
	.56	3.70		
	.25	5.04		
	.12	7.84		
		12.40		
Firpark Clover on Corner of Home Croft, next to Hunters Lane.				
		0 6 return into the Lane.		
	Bs	270° 50'		
	Lks	77 00		
		.26 int:		
		.33	.10	Hedge to John Gordons Land
		2.88	.40	
		5.60	.10	
		9.32	.9	Corner to River.

Continued onto Page 86.

Sr David Johnston's Land.

Mullowie

Mullowie

Sir Tho. Brisbane's Land

John Gordon's Land

Henry Hunter's Land

Dunlop

Dunlop

Dunlop

Dunlop

Cobbler Cr.

Cobbler Cr.

Scotch Lake

Scotch Lake

Scotch Lake

A Common.

Henry Hunter's Lands.

Home Cottage
A: 9 R: 0 P: 30

Glebe Gard.

Gent Garden

Church

Home Close
A: 6 R: 2 P: 18

Crabtree Close.
A: 8 R: 3 P: 28

Heath Field.

Long Field.

John Gordon's Land.

A Town Field
A: 8 R: 1 P: 13

Common

Madonay

O'Beaidon.
A: 7 R: 2 P: 34

Paluer
A: 10 R: 2 P: 27

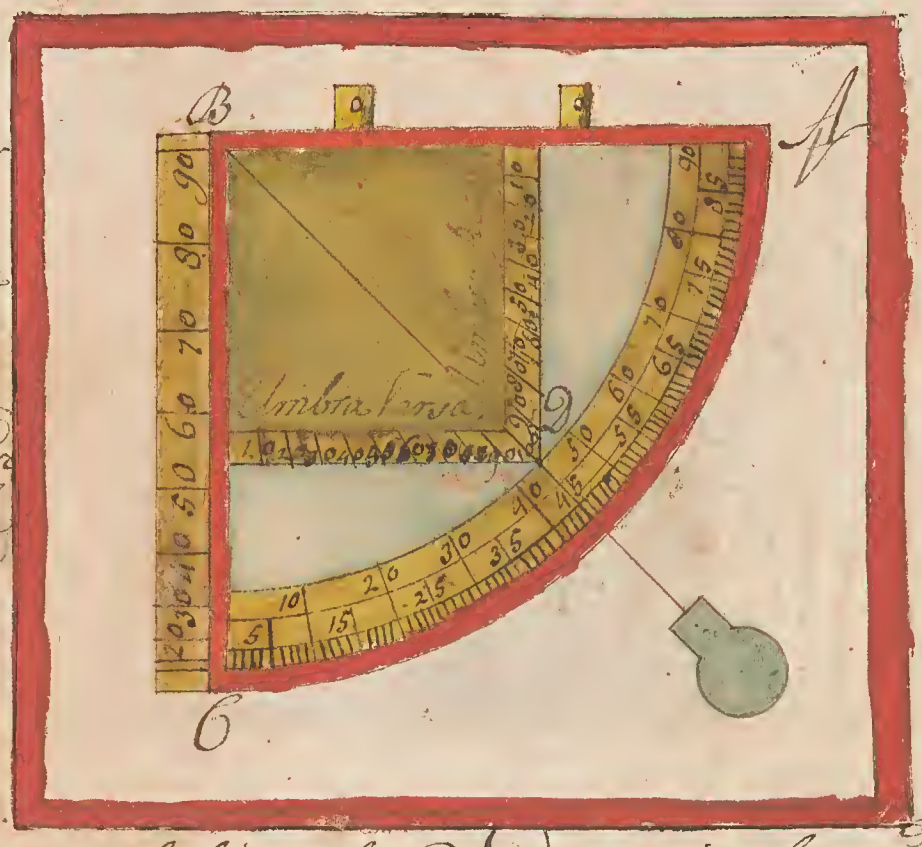
Lands

Part of Quin Johnston Lane

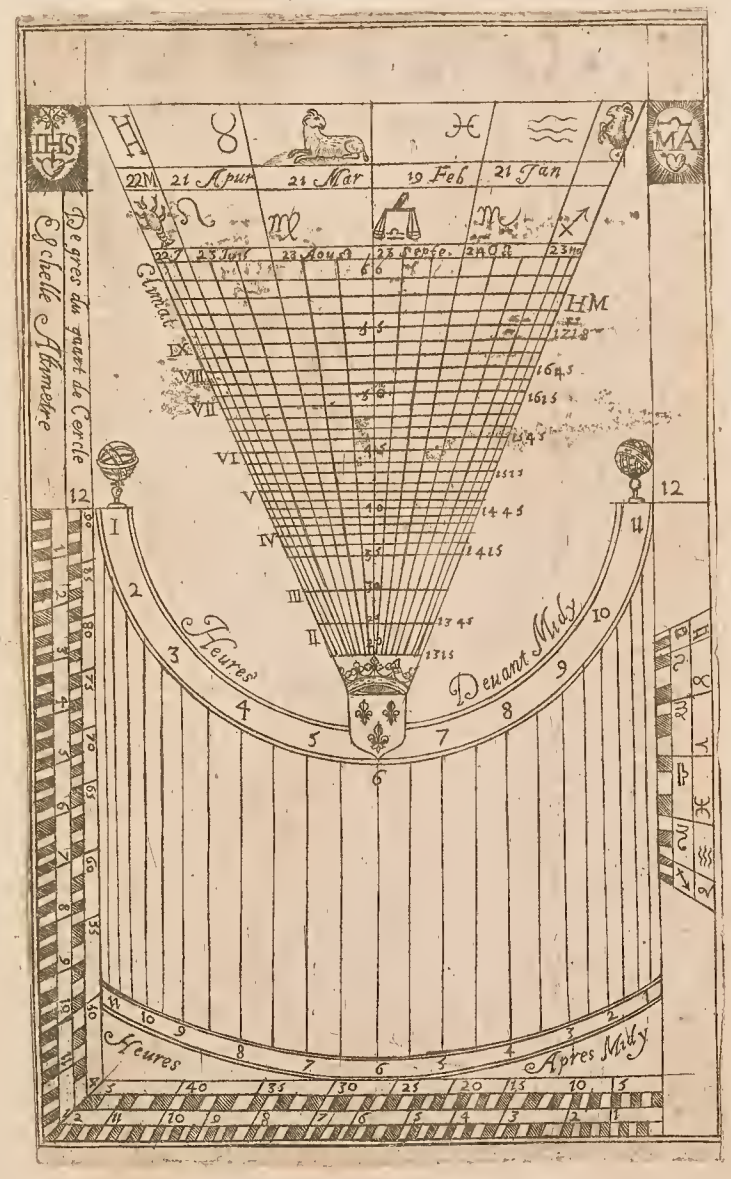
Remarks.	Offset	Station Lines	Offset	Remarks.
		O 18 in Fair Field		
	Bs	186° 00′		
	Lts	95 10		
		131 10		Angle to a Bend in ye River from O 18.
		26	.75	
	.56	1.75	.82	
	.25	2.48	.53	
		3.		
		2.25	0	Touch the River's Brink
		4.22	1.45	
		5.36	1.10	
		6.20	1.16	
		O 19 in Fair Field.		
	Bs	96° 30′		
	Lts	90 30		
		0	.86	Hedge to Fair Field con-
		1.80	0	tinued to River.
		3.90	.34	
		5.56	.50	Ag. Hedge to Conjuncture
		6.90	.76	
		10.24	.50	Close here.
Close Fair Field on Hedge next to Lane.				
		O 19 return.		
	Bs	186° 00′		
	Lts	180 00		
		.8 into		
		Into Malloway Meadow		
		.57	1.26	
		1.43	1.20	
		2.80	.42	
		3.46	.21	
		5.72	.97	
		6.65	.46	
		7.80	.8	A Bridge
		9.	.0	
		10.04	.25	
		10.45		
		O 20 in Malloway Meadow.		
	Bs	151° 00		
	Lts	145 40		
		.78	.40	
		1.54	.82	
		2.80	.75	
		3.95	.30	Corner to River.

Remarks	Offset	Station Lines	Offset	Remarks
		021 in Mallonay Meadow.		
	Bs	54° 30'		
	Lie	83 35		
		0	.28	Hedge to Mallon Meadow.
		1.	.64	
		2.45	.78	
		3.80	.59	
		4.52	27	
		022 in Mallonay Meadow		
	Bs	358° 00'		
	Lie	123° 20'		
		0	.28	
		1.47	.53	
		3.78	.28	A gate
		6.	.06	
		7.90	.30	
		8.90	.60	
		10.10	1.37	Close here.
		10.32 Corner		
Mallonay Meadow Closes on the Corner of the Ridge next Fair Field.				
		021 return		
	Bs	143° 35'		
	Lie	172° 35'		
		.22 int.		
		Into Corn-Pasture		
		.90	.06	
		2.24	.60	Corner to River.
		023, in Corn-pasture.		
	Bs	92° 50		
	Lie	129 05		
		2.05	.55	Hedge to Cornpasture
		2.45	.60	
		3.02	.66	
		4.26	.24	
		5.60	.20	
		6.80	.36	
		7.55	.58	
		8.42	.45	Close here
		9.36		
Corn-pasture Closes on Corner next Fowlers Field.				

To make a Land Quadrant.

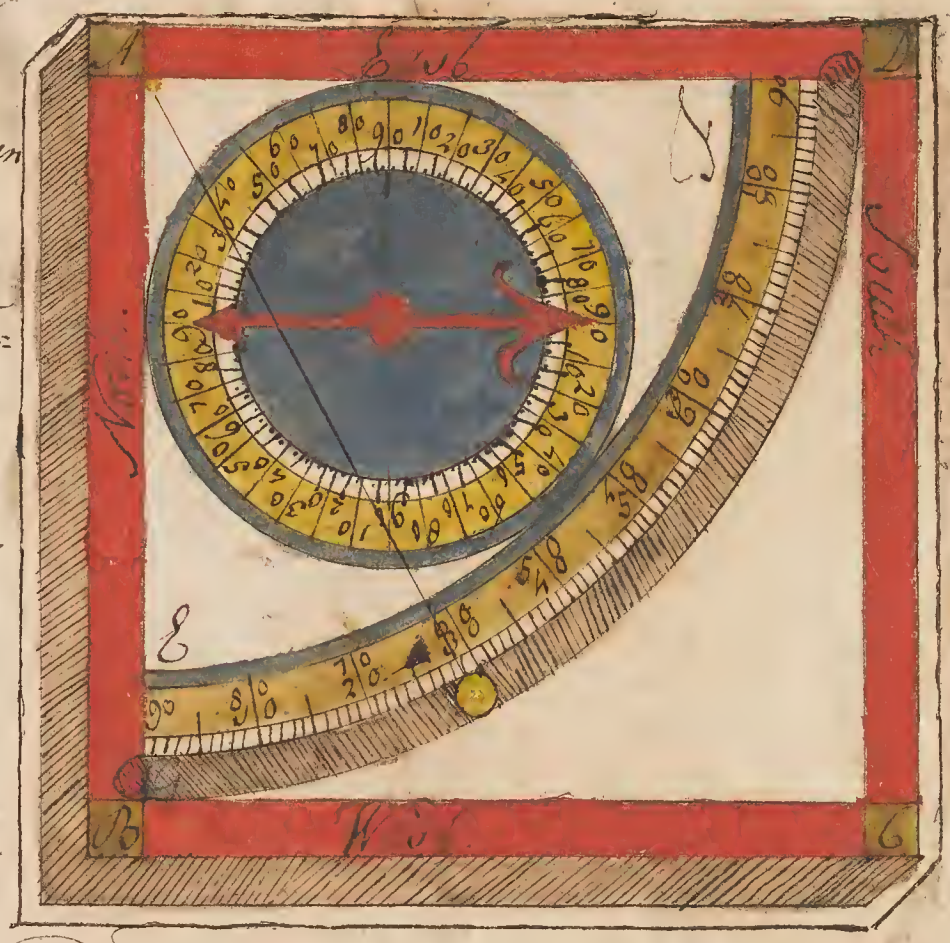


First, Draw the Line A B at pleasure and perpendicular thereto B C for the Semidiameters of the Quadrant, and upon the Center B draw the Arch or Quadrant A C which must be into 90 parts by the Line of Chords and marked 10, 20, &c; Divide the Line B C into 90 parts from y Line of Sines & mark it w.th 10, 20, 30, &c; upon the Semidiameter next the 90° place two Sights, & a Plummet on the Center to hang at full Liberty; that done, bisect the Quadrant in the middle at D, and from D let fall a Perpendicular to each Semidiameter, which will discribe a Square, or Quadrat, & divide each side into 10 equal parts and each of these into other 10 to make in all 100, & mark them with 10, 20, &c, to 100. The Side of the Square or Quadrat, which falls perpendicular to the Semidiameter in which the Sights are placed, is called Umbra Recta, and the other Umbra Versa.



A Description of a Clinatory or Declinatory.

A Declinatory is made of a Piece of Square Board, as A B C D, of a good thickness, the larger the better, Between two of the Sides is Described on the Center A a Quadrant, as E F, divided into 90 equal Parts or Degrees, which are figured from 10, 20, to 90, and then back again with the Compliements of the same Numbers to 90. Between the Limb and the two Semidiameters is made a round Box, into which a Magnetical Needle is fitted, and a Chart of the Nautical Compass, each Quarter being divided into 90 Degrees, beginning the Numbers at East, West, North, and South points of the Compass, from which Points of the Compass the opposite Sides of the Clinatory receive their Names of East, West, North, South.



N: B: the North point of the Chart must be placed so many Degrees towards the East or West sides of the Clinatory, as the Needle varies from the true North Point of the World in the Place where it is to be used.

Upon the Center A, where on the Quadrant is described, is fastned a Plumb-Line having a Plummet of Lead, or Brass, fastned to the end of it, which Plumb-Line is of such a length that the Plummet may fall into the Groove G H below the Quadrant, which is for that purpose made of such depth, that the Plummet may ride freely in it without stoping at the Side of it.

With this Clinatory you may examine the situation of a Plane, as if your Plane be Horizontal it is Direct, and then for the true situating a Dial you have only the true North and South to find, which is done by setting the Clinatory flat down upon the Plane, turning it towards the right or left hand, till you can bring the North Point of the Needle to hang just over the Flower-De-Luce; then draw a line by either of the Sides parellel to the Needle, and that Line shall be a North & South Line.

If your Plane Recline or Incline, apply one of the Sides of the Clinatory parallel to one of the Sides of the Quadrant to the Plane in such a manner, that the Plumb Line hanging at Liberty may fall upon the Circumference of the Quadrant; for then the Number of Degrees comprehended between the Side of the Quadrant parallel to the Plane and the Plumb-Line shall be the Number of Degrees for Reclination, if the Center of the Quadrant points upward; or for Inclination, if the Center points downwards

Downwards.

If the reclining or inclining Plane Decline, draw upon it a Line paral-
lel to the Horizon, which you may do by applying the backside of the Clina-
tory, and raising or depressing the Center of the Quadrant till the Plumb-
Line hang upon one of the Semidiameters; for then you must by the upperside
of the Clinatory draw an Horizontal Line, if the Plane incline; or by the un-
derside, if it Recline; if it neither Incline nor Recline, you may draw an Ho-
rizontal Line both by the upper and undersides of the Clinatory.

Having drawn an Horizontal Line, apply the North Side of the Clina-
tory to it, and if the ~~the~~ North end of the Needle points directly towards the Plane,
then it is a South Plane; if the North Point of the Needle points directly from
the Plane, it is a North Plane; but if it points directly towards the East, it is an
East Plane; if to the West, a West Plane; if it does not point either East, West, North,
or South, then so many Degrees is the Declination of the Plane.

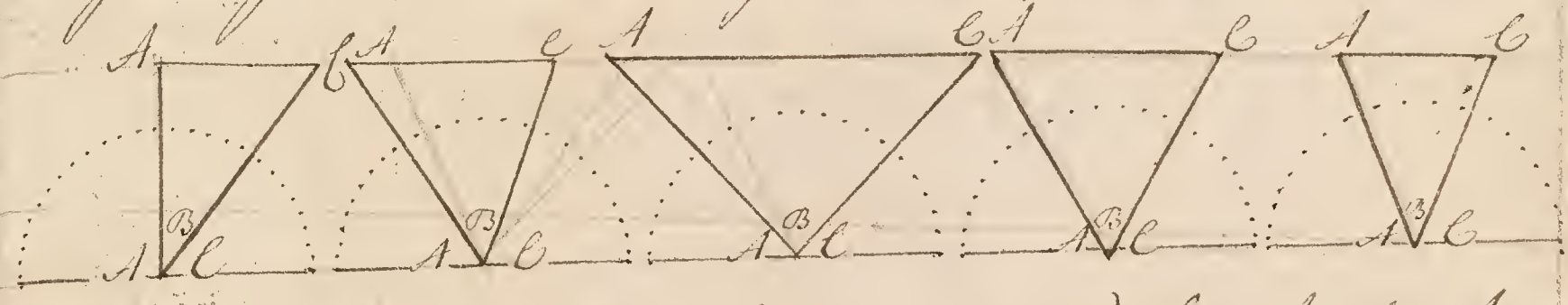
Plain Trigonometry.

The Properties of Plain Triangles.

In every Triangle the greatest Side is opposite to the greatest Angle; and equal Sides make equal Angles, whence all the Angles of an Equilateral Triangle, and the Angles at the Base of an Isosceles Triangle are Equal.

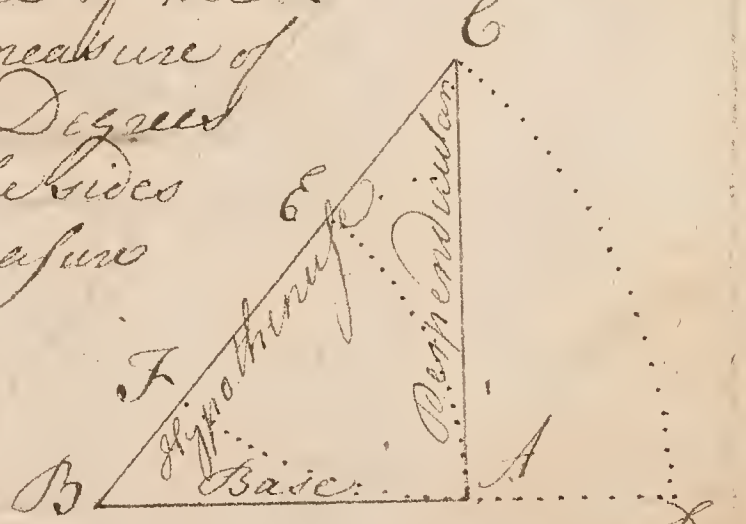
In every Triangle, Right Angled, or Obligue, the three Angles taken together are equal to 180 Degrees; Therefore, if an Acute Angle be given in a Right Angled Triangle, the other Acute Angle is its Complement to 90; & is thus proved;

Right Angled. Scalene. Ambligonium, Equilateral. Isosceles.



In all these Triangles (by Euc: 1:1st prop: 29th) the Angle A without is equal to the Angle A within the Semicircle, the Angle C without equal to the Angle C within, & the Angle D is contained already in the Semicircle; But a Semicircle contains 180°. Therefore the three Angles of a Triangle contain 180°.

The Arches are measures of their opposite Angles, as the Arch C D is the measure of the Angle B; The Arch F A is the measure of the angle C, These Arches are Degrees & Minuts of the Firmament, & the sides are the length of any Kind of measure upon Land or Sea.



The side B C is called the Hypothenuse, A C the Perpendicular, and B A the Base.

In every Right Angled the Length of any of the Sides being made Radius; Then will the other sides be either Sines, Tangents, or Secants. Thus, if B C is supposed Radius, then are the other two sides B A & A C the Sines

of

of their opposite Angles. If C A is supposed Radius, then is B A the Tangent of the Arch F A, and the side B C the Secant of the Angle C. If B A is supposed Radius, then is C A the Tangent of the Angle B. & B C the Secant of the Angle B.

Theorem. In all plain Triangles the Sides are proportional to the sines of their opposite Angles; That is, As the Arch F A is to the Side B A so is the Arch C D to the side C A. In this Canon the Hypothenuse is the supposed Radius.

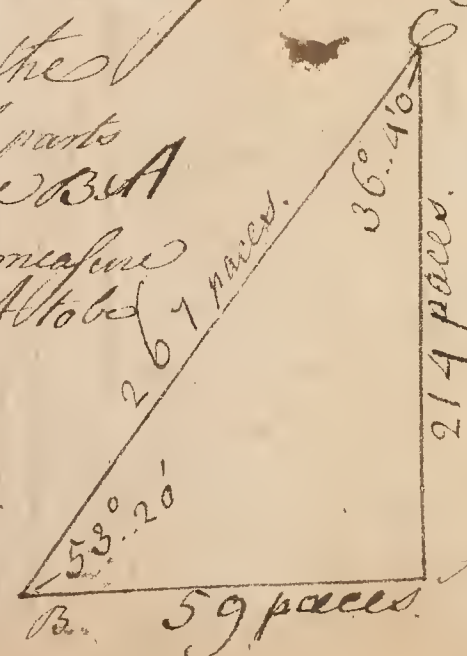
Of Plain Trigonometry

Rectangular.

Case 1. Given the Hypothenuse B C & the Angle C, to find the Perpendicular C A & y Base B A. Ex. Given the Obligue Side of a Hill B C measured to be 267 paces & the Angle taken to be 36° 40', to find the perpendicular Height of the Hill C A, & how far may be digged from the Foot of the Hill at B to be just under y Top at C.

Geometrical Construction.

Draw C A of any length, set the Chord of 60° in C and make an Arch ~~upon which set~~ on the given Angle, make the Arch of that Extent; then the length of the Hypothenuse taken from the Scale of Equal parts & laid upon the side C B, then let the Line B A fall from the point B and it's done. Then measure B A and A C upon a Scale & you'll find B A to be 59 paces & A C 214 paces.

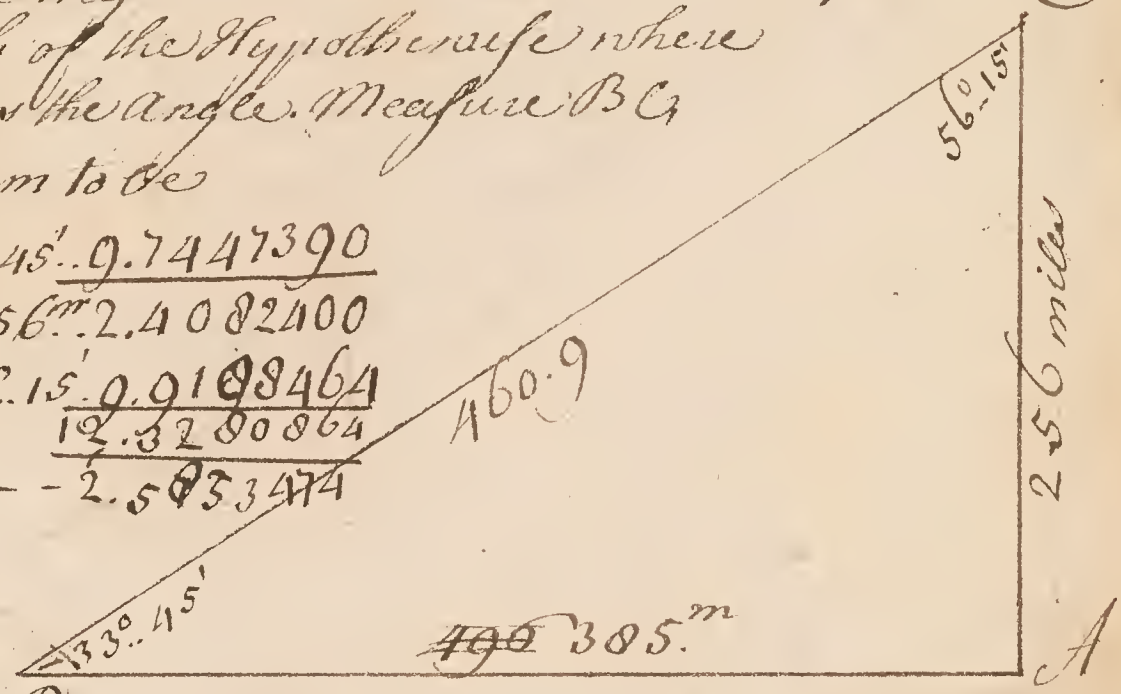


As Radius B C 90° ---- 10.0000000
To the Hypothenuse B C 267m --- 2.4265113
So is the Sine Angle 36°. 40' -- 9.7760897
To the Base B A 59m ---- 2.2926810

As Radius BC of 90° ——————— 10.0000000
Is to the Hypothenuse B C 267m —— 2.4265113
So is the Sine of the Angle 53°20 —— 9.9042411
To the Perpendicular A C 214m —— 2.3307524

Case II. The Angle C and Perpendicular given, to find the length of the Hypothenuse B C and Base B A.
Ex: Given the Angle C 56° 15′ and Perpendicular C A 256m to find B C and B A.

Geo: Const: From any Scale of Equal parts lay Down the Perpendicular C A, Upon A raise a line at right Angles of length at pleasure, then, set the Chord of 60° in C & set on the given Angle a Ruler laid to C and mark & draw the length of the Hypothenuse where it meets the Base frames the Angle. Measure B C and B A & you'll find them to be

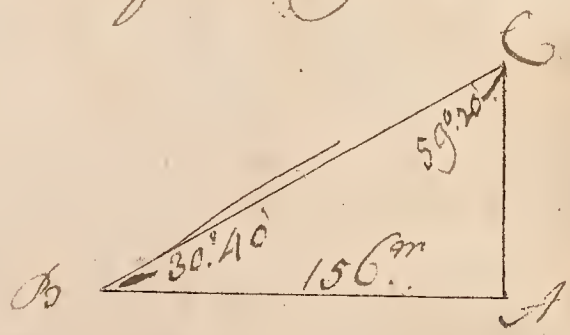


As the Sine of Angle B 33° 45′ .. 9.7447390
Is to the Perpendicular A C 256m .. 2.4082400
So is the Sine of the L^e C 56°.15′ .. 9.9198464
Is to the Base B A 385m ——— 12.3280864
2.5833474

As the Sine of the Angle B 33° 45′ 9.7447390
Is to the Perpendicular A C 256 miles. . 2.4082400
So is Radius 90° ——————— 12.4082400
To the Hypothenuse 460.9 miles 2.6635010

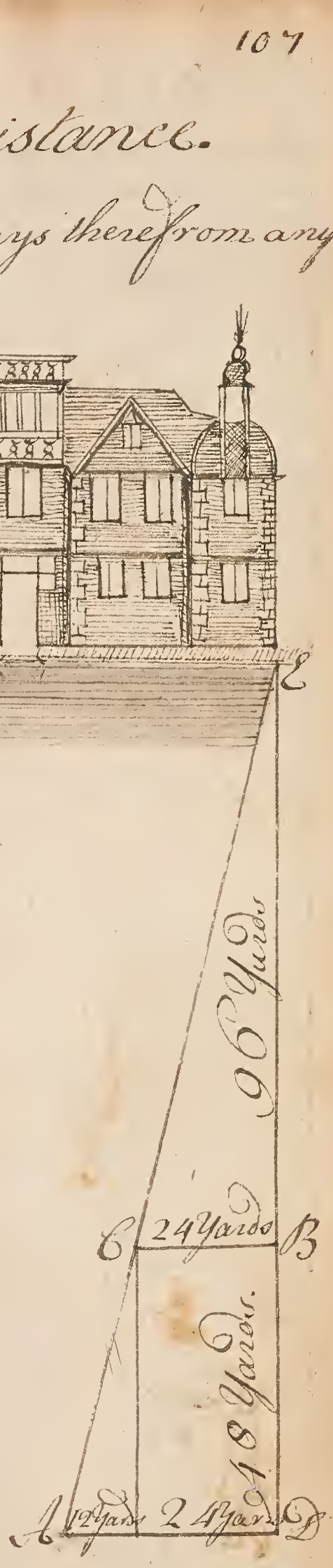
Case III. Given the Angle B & Base B: A: to find the Hypothenuse B: C: & Perpendicular C: A: Ex:

Geo: Const: From any Scale of Equall parts lay down the Side Base B. A.



To find an Horizontal Distance.

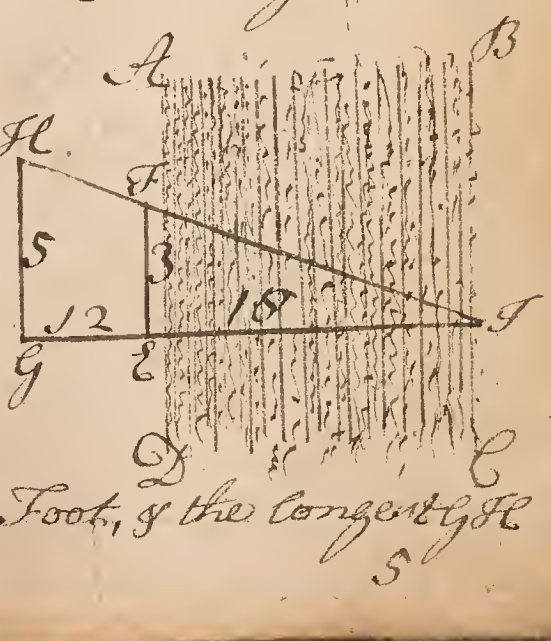
First, Set up a Staff at B, and go sideways therefrom any Number of Yards or Feet, as for Ex: to C; and their put up another; then return to B and go back in a strait Line from the Object keeping the Staff at B between you & the Object, untill you come to any Number of Yards or Feet, and there put up a 3d Staff; then go upon a Perpendicular Line from D any Number of Feet or Yards to A, till you see the Object from A in a streight Line with C, and there set up a Fourth Staff; then, as the difference of DA & BC is to BD the distance gone back, so is DA to the true distance between you and the Object E. Example. Let it be required to find the Distance between B and the Object E. First set up a Staff at B, travel on a Perpendicular Line to C 24 Yards, and there set up another Staff; then return to B, and go back in a streight Line from B to D 48 Yds, and there put up another Stick; then travel from D to A in a Perpendicular Line 36 Yards, Where you see the Object over C, and there set down a fourth Staff; and it is required to find the Distance between the House at E and the station at B, which in this Ex: is 96 Yards.



DA 36 — BC 24 = 12 : BD 48 :: DA 36 : DE 144. And DE 144 — BD 48 = BE 96 Yards the distance between the House at E and the Station B.

To measure with two Sticks an Horizontal Line accessible only at one of it's Extremities.

To know the Length of the Line EI (the Breadth of the Ditch or Water A.B C D) accessible only at E; Set up Perpendicular at E the least of the Sticks EF, and the greater of the two GH at such a distance from the first, that you may just perceive the Extremities over the two ends H & F; measure the Distance EG which is here supposed 12 Foot, as also the shortest of the two Sticks EF 3 Foot, & the longest GH



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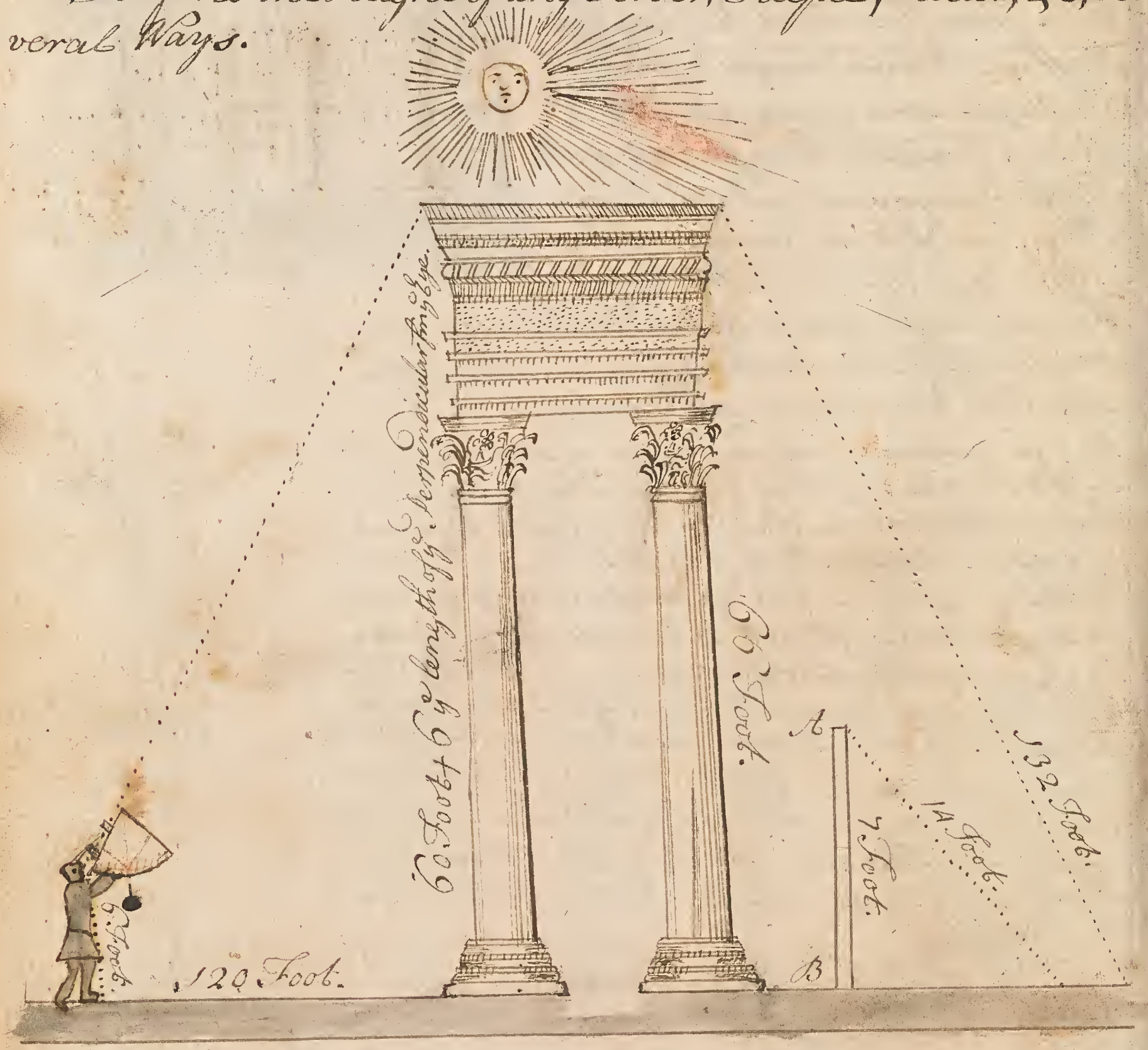
5. Foot; take the excess of the Greatest above the least which here is 2 Foot, and let it be the first Term in a Question of the Rule of Three Direct, 12 or the distance E G the 2d, 5 or the length of the stick G F the 3d Term, and the 4th will be E. I or the length sought; & so you'll have 18 Foot for the Length of the Line proposed.

To find the Height of any Tower, Steeple, Pillar, &c, several Ways.



1. Fix your Quadrant towards the Pillar &c whose Altitude you require untill you behold thro' both the sights the very summet or top which found manly well the Division or Points in the Square in the Threed and Plummet did fall on & if they be of a right Shadow that is to say when the Threed and Plummet falls on that side of the Square which is next the Sights then say as the Parts cut is to the whole Scale so is the Length of the Base to the Altitude of the Pillar &c and therefor multiply the Distance from you to the Base by 12 Divide the Product by the Parts cut off all of the Plummet and the Quotient will show you the Altitude required. But if the Threed fall upon the Contrary Shadow

Then

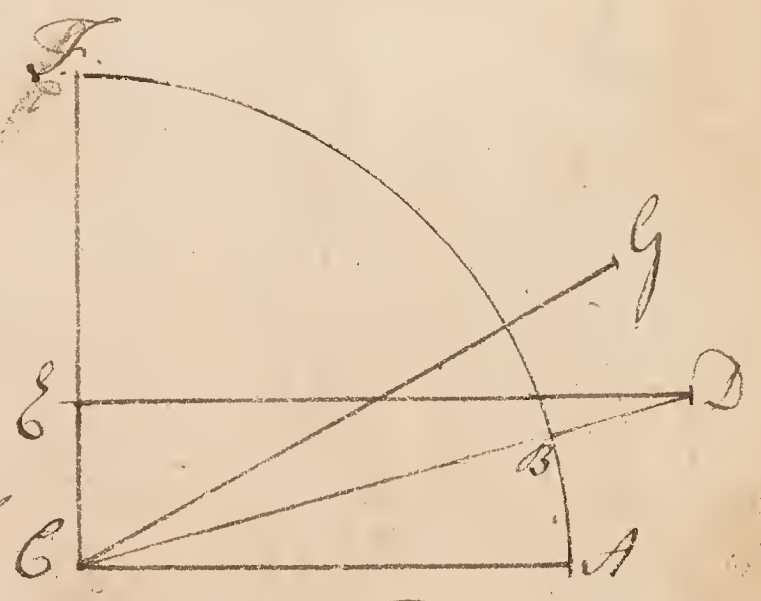
Then say as the whole Scale is to the Parts cut so is the Length of the Base to the Altitude required therefor Multiply the Base by the Parts cut the Product Divide by the whole Scale, and the Quo:=tient is your desired Altitude above the Eye. Ex: Suppose the Thread with the Plummet should happen to fall upon Six Parts of the Contrary Shadow the Distance from your Standing to the Base of your Pillar be 120 Foot I say as its whole Scale 12 is to the Parts cut 6 so is the Length of the Base 120 Foot to the Altitude of the Pillar 60 Foot Multiply the Base 120 by the Parts cut 6 the Product 720 Divided by 12 the Quotient is just 60 ft. so many Foot high is that Pillar &c above the Level of the Eye. Suppose then Perpendicular from y^e Eye to y^e Ground to be 6 Foot by y^e whole height of y^e Pillar will be 66 Foot.

2. If the Pillar &c be Accesible then hold your Quadrant up towards it looking deligently through both sights going backward and for untill the Line of the Plumet fall of 45° which found measure the Dis=tance between your standing and the Base for that is the just Altitude of the Pillar above the Level of the Eye as required.

3. To measure the Accesible Height of the Pillar &c by means of its Shadow. Set up Perpendicular a Stick A B of what length you will suppose 7 Foot and measure the extent of its Shadow which we suppose to be 14 Foot, say by the Rule of Three Direct if 14 Foot of a=ny Shadow arise from the Height of A B or 7 Foot from what height must the Shadow of the Pillar of 132 Foot proceed. Here you will find the height of the Pillar in y^e Question to be 66 For multiplying the 3^d Term 132 by the second Term 7 and dividing the Product 924 by the 1st Term 14 you have 66 for y^e 4th Term or the height of y^e Pillar.

To find the Altitude of the Sun at any Time without a Quadrant or such like Instrument.

On any plain Place erect a Pin or Wire perpendicularly as in the Point C: From which Point, you had before to 60 of a Line of Chords, Describe the Quadrant=al Arch A F, make C E equal to the height of the Pin or Wire, and through E draw E D parellel to C A, & make it equal to C G the Length of the Shadow. Then will a Ruler laid from C to D, intersect the Quadrant in B, and B A is the Arch of the Sun's Altitude, when mea=sured on the Scale of Chords.



A Table of Plain Angles, continued under Sides of 30 Feet.

Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '
2	00..59	2	6..3	2	11..48	2	17..34	2	23..24	2	29..17	2	35..15	2	41..19	2	47..30	2	53..51
4	00..38	4	6..22	4	12..8	4	17..54	4	23..44	4	29..37	4	35..35	4	41..40	4	47..51	4	54..12
6	00..57	6	6..41	6	12..27	6	18..13	6	24..3	6	29..56	6	35..55	6	42..0	6	48..12	6	54..34
8	1..17	8	7..0	8	12..46	8	18..32	8	24..23	8	30..16	8	36..15	8	42..20	8	48..33	8	54..55
10	1..36	10	7..20	10	13..5	10	18..52	10	24..42	10	30..36	10	36..35	10	42..41	10	48..54	10	55..18
1	1..55	4	7..39	7	13..24	10	19..11	13	25..1	16	30..55	19	36..55	22	43..1	25	49..15	28	55..38
2	2..14	2	7..58	2	13..43	2	19..30	2	25..21	2	31..16	2	37..15	2	43..22	2	49..36	2	56..0
4	2..33	4	8..17	4	14..2	4	19..50	4	25..41	4	31..36	4	37..36	4	43..42	4	49..57	4	56..22
6	2..52	6	8..36	6	14..22	6	20..19	6	26..1	6	31..56	6	37..56	6	44..3	6	50..18	6	56..43
8	3..11	8	8..55	8	14..41	8	20..29	8	26..20	8	32..16	8	38..15	8	44..24	8	50..39	8	57..5
10	3..30	10	9..14	10	15..0	10	20..48	10	26..40	10	32..35	10	38..36	10	44..44	10	51..0	10	57..26
2	3..49	5	9..34	8	15..20	11	21..8	14	26..53	17	32..55	20	38..56	23	45..5	26	51..21	29	57..48
2	4..8	2	9..53	2	15..39	2	21..27	2	27..13	2	33..15	2	39..17	2	45..26	2	51..42	2	58..10
4	4..28	4	10..12	4	15..58	4	21..46	4	27..38	4	33..35	4	39..38	4	45..46	4	52..3	4	58..32
6	4..47	6	10..31	6	16..18	6	22..16	6	27..58	6	33..55	6	39..58	6	46..7	6	52..24	6	58..54
8	5..6	8	10..50	8	16..37	8	22..25	8	28..18	8	34..15	8	40..18	8	46..28	8	52..45	8	59..16
10	5..25	10	11..9	10	16..56	10	22..45	10	28..38	10	34..35	10	40..38	10	46..48	10	53..8	10	59..38
3	5..44	6	11..27	9	17..15	12	23..6	15	28..57	18	34..55	21	40..59	24	47..9	27	53..29	30	60..0

Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '	Bases.	Angles. ° '
2	60..22	2	67..7	2	74..8	2	81..30	2	89..18	2	97..10	2	106..48	2	117..2	2	129..3	2	144..39
4	60..44	4	67..30	4	74..32	4	81..55	4	89..45	4	98..9	4	107..20	4	117..39	4	129..46	4	145..43
6	61..6	6	67..53	6	74..56	6	82..20	6	90..12	6	98..38	6	107..52	6	118..16	6	130..33	6	146..48
8	61..28	8	68..16	8	75..20	8	82..46	8	90..39	8	99..8	8	108..25	8	118..53	8	131..19	8	147..57
10	61..50	10	68..39	10	75..44	10	83..12	10	91..6	10	99..37	10	108..57	10	119..31	10	132..6	10	149..8
31	62..13	34	69..2	37	76..9	40	83..37	43	91..33	46	100..6	49	109..30	52	120..9	55	132..53	58	150..20
2	62..35	2	69..25	2	76..33	2	84..3	2	92..1	2	100..36	2	110..4	2	120..47	2	133..44	2	151..35
4	62..58	4	69..48	4	76..57	4	84..29	4	92..29	4	101..6	4	110..37	4	121..26	4	134..30	4	152..55
6	63..20	6	70..12	6	77..22	6	84..54	6	92..56	6	101..36	6	111..11	6	122..6	6	135..20	6	154..19
8	63..43	8	70..35	8	77..46	8	85..20	8	93..24	8	102..7	8	111..44	8	122..45	8	136..11	8	155..48
10	64..5	10	70..59	10	78..9	10	85..46	10	93..52	10	102..37	10	112..18	10	123..25	10	137..3	10	157..22
32	64..28	35	71..22	38	78..35	41	86..13	44	94..20	47	103..8	50	112..53	53	124..6	56	137..57	59	157..3
2	64..50	2	71..46	2	79..0	2	86..39	2	94..48	2	103..39	2	113..28	2	124..47	2	138..49	2	160..53
4	65..13	4	72..10	4	79..25	4	87..5	4	95..16	4	104..10	4	114..3	4	125..28	4	139..44	4	162..54
6	65..36	6	72..33	6	79..50	6	87..32	6	95..20	6	104..41	6	114..38	6	126..10	6	140..40	6	165..12
8	65..58	8	72..56	8	80..15	8	87..58	8	96..13	8	105..12	8	115..14	8	126..52	6	141..38	8	167..48
10	66..21	10	73..20	10	80..40	10	88..25	10	96..42	10	105..44	10	115..49	10	127..35	10	142..36	10	171..28
33	66..44	36	73..44	39	81..5	42	88..51	45	97..11	48	106..16	51	116..26	54	128..19	57	143..36	60	180..0

In the Columns of Bases, in the above Table, are only set down every 2 Inches and the Feet from 1 to 60. Now the Quantity of any Angle is by the Table thus, Viz. Suppose the Base be in Length 50 feet, 3 Inches, & the other two Sides 30 foot each, which they must always be: Seek 50 feet 2 Inches, in the Col. of Bases, and against it in the Col. of Angles is 113..28: whence by proceeding due proportion with the Inches & Minutes, the Angle will be found to be 113° 41'.

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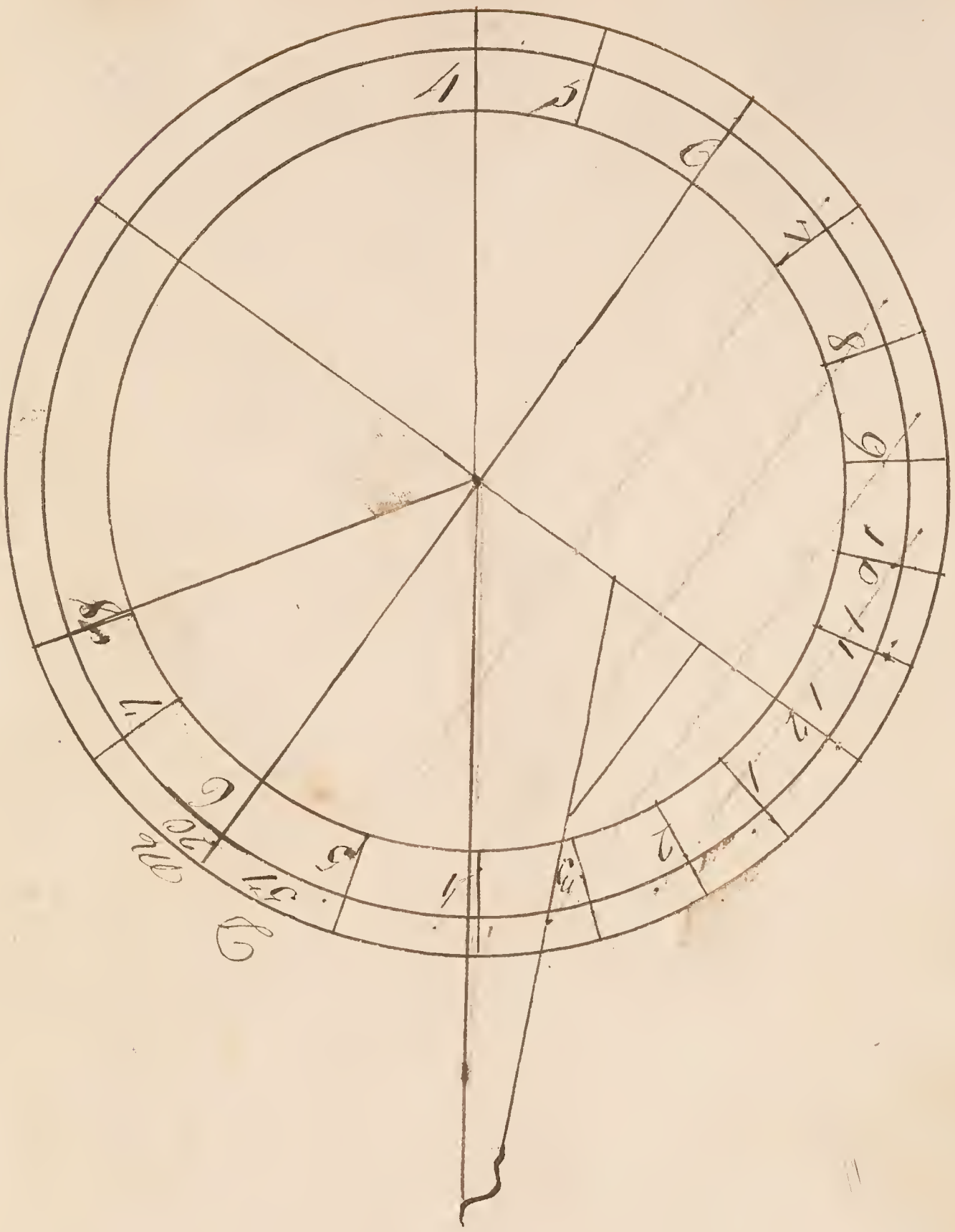
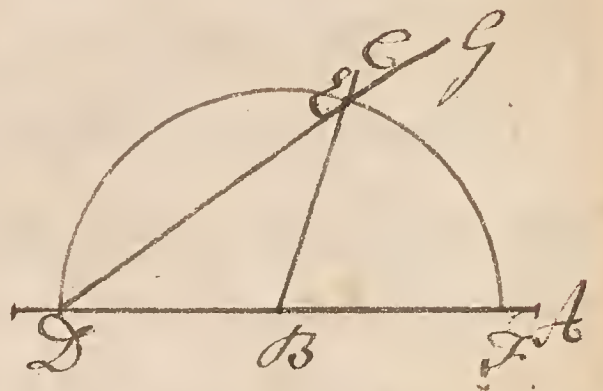


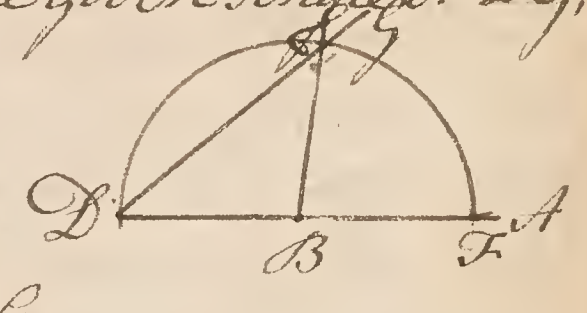
Geometrical Problems.

Pr. To make an Angle equal to the half of an Angle given.

To make an Angle equal to the Half of the given Angle A B C; describe upon it's point B Semicircle you will cut D E F, & draw the right line D E which will form at the point D the Angle A D G equall to the half of the given Angle A B C.

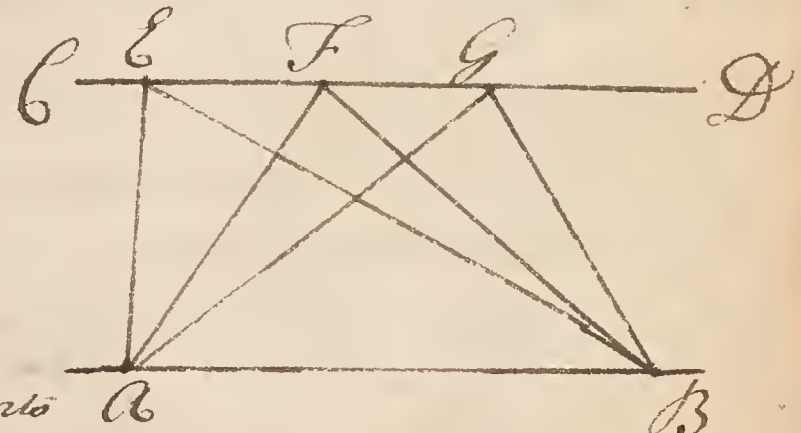


For an Angle equal to the double of the given Angle A D G; fix the Point B upon any Part of the Line A D, and from thence at the Distance B D describe a Circle D E F, & join the Line B E which will form at B the Angle A B E equal to the double of D G.



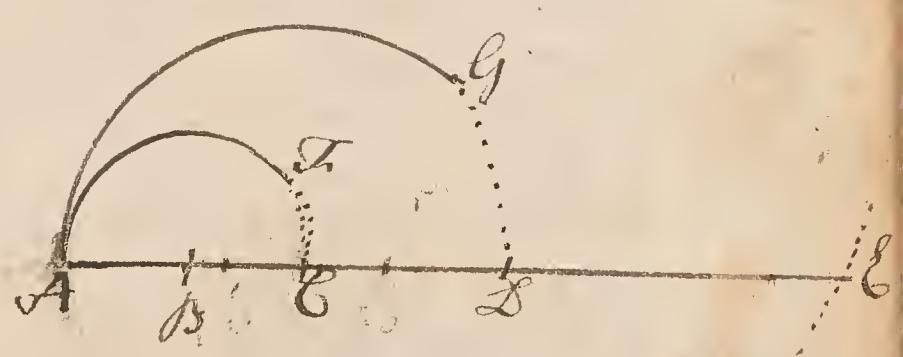
Prob: 2. To describe upon a Line given as many different Triangles as you please with equal Areas.

If the given Line be A B, draw at pleasure the parellel C D, upon wch mark at Discretion as many different points as you would have equal Triangles as E, F, & G; for these 3 Triangles draw from these 3 points right Lines to A & B y^e extremities of the given Base, Then you have three equal Triangles as A E B, A F B, A G B.



Prob: 3. To find a third proportional to two Lines given & as many other proportionals as you will.

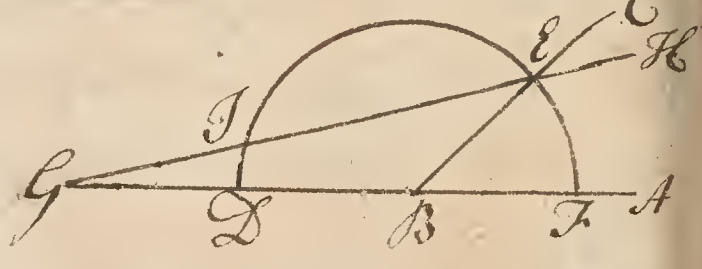
Let the two Lines given be A B & A C, to find a third proportional to them describe from B the end of the first Line, at the distance B A, y^e Arch of a Circle A F, upon that Arch take the length of a second Line A C from A to F, then set off from F the same length upon the Line A C prolonged as far as you have occasion, wch will reach to D, & A D will be a third pro=portional to the given Lines A B & A C. In like manner to find a 4th proportional to y^e 3 Lines A B, A C, A D, describe from C y^e End of the first Line A C, with the Compasses opned to A, y^e Arch of the Circle A G, upon



Which set off the length of the other Line A D being prolonged, set off ye same distance from G vn will reach to E & ye Line A E will be ye Line you want.

Prob: 4. To make an Angle equal to the third part, or to ye triple of an Angle given.

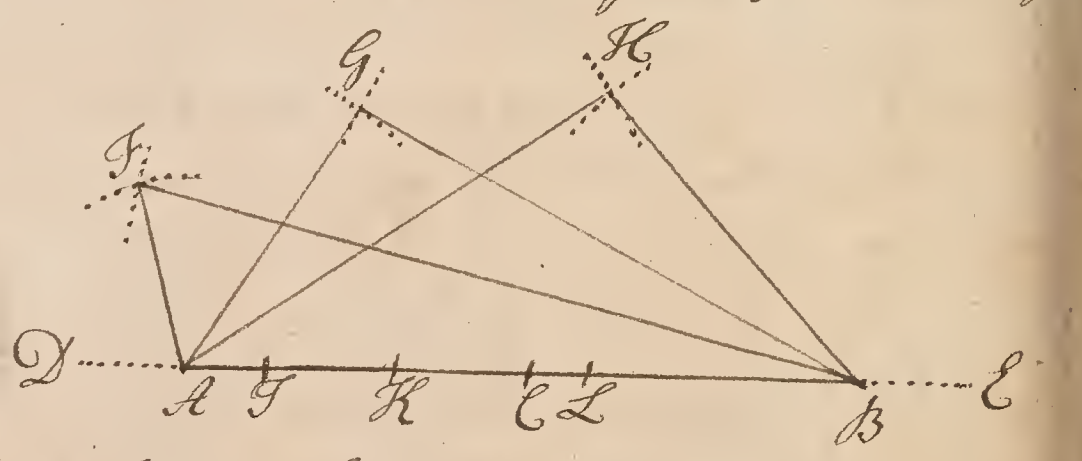
First for an Angle equal to the third part of the given Angle A B C, describe at pleasure from it's point B the Semicircle D E F, & apply a straight Ruler to E in such a manner that it's part G I, terminated by ye Circumference D E F & by the Line A D prolonged, may be equal to the Semidiameter B D or B E; then draw the right Line G E, vc will form, at the point G, ye Angle A G H equal to 1/3 of the Angle A B C, and consequently ye Arch I D will likewise be equal to 1/3 of ye Arch E F.



In the second place, for an Angle equal to the triple of the Angle given A G H, take ye Point I at Discretion upon the Line G H, upon vn setting one Foot of your Compasses, & with the distance I G make an Arch vc will cut the Line A G in ye Point B, upon vn with the same distance describe the Arch E F & draw the Line B C cutting the Semicircle & ye Line G H at E; So will the Angle A B C be triple of the Angle A G H.

Prob: 5. To describe upon a given Line any demanded Number of different Triangles the Circumference of which is Equal.

If the Base given is A B, divide it equally at the Point G & lengthen it at each end at pleasure to D & E, for instance, making the two Lines G D & G E equal & taking the whole Line D E for the Sum of the two Sides of each Triangle that is to be described on the given Base A B after this manner, Viz from the Point A describe, vn the Compasses a little more open than A D, the Arch of a Circle, & apply the same Aperture to the Line D E streaching from D to I, describe from ye Center E another Arch of a Circle, vc here cuts the First at F, & shall be the Top of the first Triangle A B F.



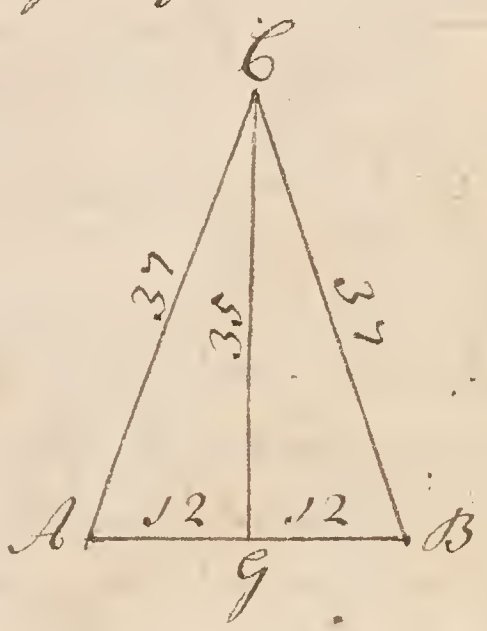
In like manner, Draw from ye Point A, vn an Aperture somwhat larger than A F, an Arch of a Circle, & setting off the same distance upon ye Line D E, streaching from D to K, describe from the Point B, at the distance K E, another Arch of a Circle that cuts the former at G, vc will be the Top of the second Triangle A G B, the Circumference of vn is equal to the first.

J J

If you draw a third Triangle, draw from the Point A an Arch of a Circle wth the Compasses opned a little more than the length A G, and having sett off the same distance upon the Line D E, from D to L describe from the point B, wth the interval L E, another Arch of a Circle that here cuts the former at H, wch is the Top of the Triangle A H B.

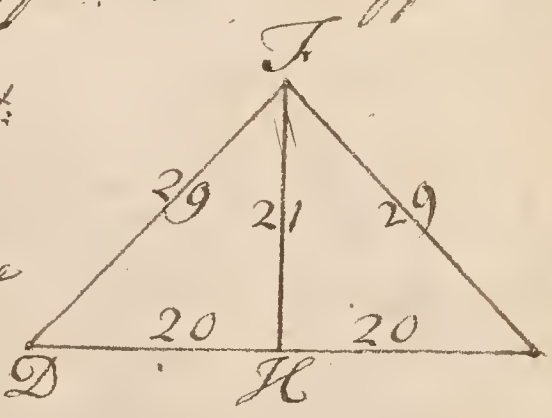
N B: F G and H the tops of these Triangles fall upon y^e Circumference of an Ellipsis, the great Axis of it D E and the two Focuses A B.

Prob: 6. To describe two different Triangles of the same Area and same Circumference.

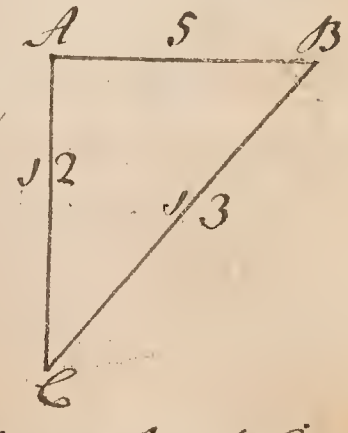


Having prepared a Scale of Equal Parts of what length you please, Take upon it the Base A B, the two parts or Segments G A & G B, each of which is equal to 12 parts, upon the Sale, from the Point G, upon the Base A B, raise the Perpendicular G C equal to 35 of the same Parts, and join the two Equal Lines A C and B C which will be found to be 37 Parts, as will appear by adding 144, the Square of the Segment A G, to 1225, the Square of the Perpendicular C G, and by Ex:=tracting the Square Root out of this Sum 1369 which is 37.

To have a Triangle of the same Area & Circumference wth that described above. Upon the Base D E divided into two equal Parts being 20 each, from the Point H raise a Perpendicular H F of 21 parts, join the equal parts E F & D F, each of which will be 29 parts; as will appear by adding 441, the Square of the Perpendicular H F, to 400, the Square of the Segment D H, and extract:=ing the Square Root of the Sum 841: Thus you have the Isosceles Triangle D E F the Circum:=ference of which 98 is equal to the Circumference of the two Sides of the first Isosceles Triangle A B C, and of which the Area & content 420 is equal to that of the same first Triangle; as appears by multiplying D H by F H, or 20 by 21, because the Product 420, arising from hence for the Area of the Triangle D E F, is the same with multiplying 12 by 35 in the Triangle A B C.

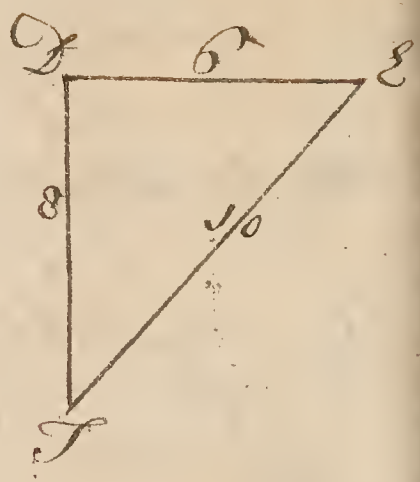


Prob: 7. To describe a Rectangle Triangle the Area of which in Numbers is equal to y^e Circumference.



Draw two perpendicular Lines A B & A C, the first A B to contain 5 equal parts taken from the Scale of equal Parts, the other 12 from the same Scale then draw the Hypothenuse B C which will contain 13 E:=qual parts as appears by adding 25 & 144 the Squares of the two sides A B & A C, & extracting the Square Root out of the Sum, y^e Area of the Rectangle Triangle will be equal to its Circumfer:=ren:=

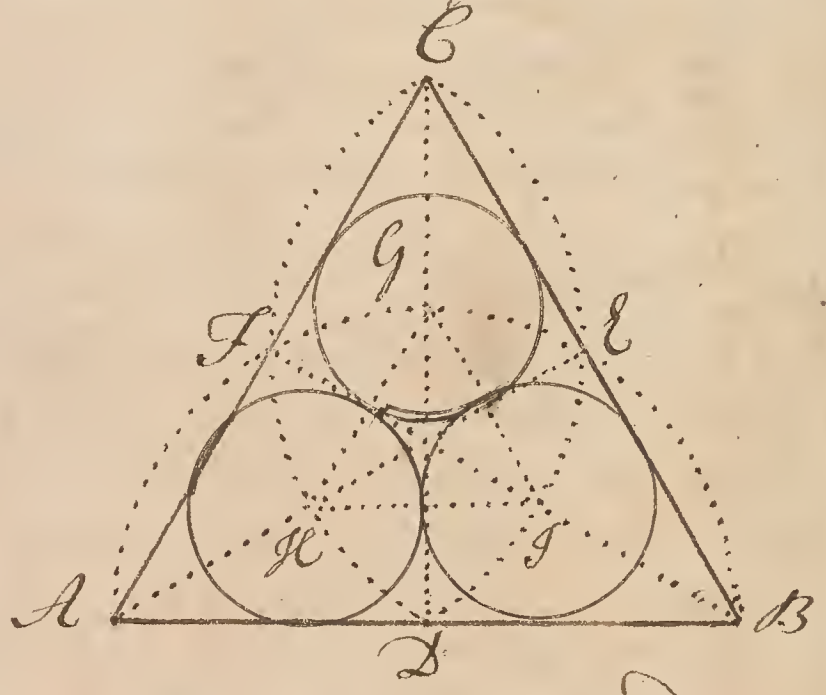
Circumference, or the Sum of its Sides, viz 30.



The same is the quality of a Rectangle Triangle made of 6, 8, & 10 in Numbers, the Area and Circumference being either of them 24. No Rectangle Triangle hes this Quality in Integers, but these two, viz 6, 8, 10, and 5, 12, 13: but in Fractional Numbers there may be found of this sort in Infinitum.

A General Rule, which is grounded on Demonstration, for finding in Fractional Numbers Trianeles of the Quality of the foregoing Problem. From a Rectangle Triangle of any Square Number & the same Square Augmented by the Addition of 2, then divide this Triangle by the Square Number in order to have a 2d Rectangle Triangle the Area of which is equal to its Circumference. Ex: Take 9 & 11, and frame this Rectangle Triangle 40, 198, 202, & divide it by 9 you have another Rectangle Triangle $\frac{40, 198, 202}{9}$ the Area & Circumference of wch is equal, being each of them $\frac{9480}{9}$. In like manner, if from 16 & 18 you frame the Rectangle Triangle 68, 576, 580, & divided by 16, you have the other Triangle $\frac{7, 144, 143}{4}$, & Circumference & Area of which is equal being each $\frac{1332}{2}$, and so on.

Prob: 8. To Inscribe within an Equilateral Triangle three equal Circles, that mutually touch one another & also the three sides of the Triangle.



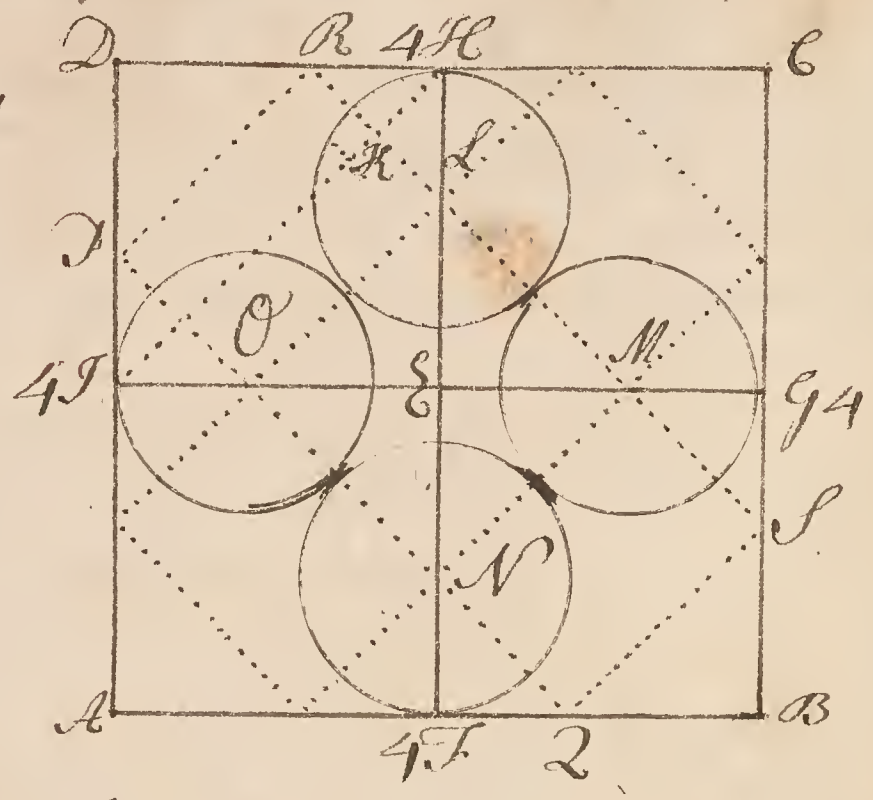
Let the Triangle be A B C. Divide each of its sides into two equal parts at the Points D, E, F, and from these points draw to the opposite Angles straight Lines, upon which you are to take the Centers G, H, I, by setting off upon each perpendicular Line the half of each side of the Triangle, viz, from D to G, from E to H, & from F to I. Here you have the Parellel Triangle H I G, and three equal Trapezia, A H I B, B I G C, and C G H A, three of the sides being equal to the Triangle H I G, and the Area of each equal to 8 parts of the Square of A B.

Prob: 9. To Inscribe in a Square given four equal Circles, which touch one another, & likewise the Sides of the Square.

Let the Square given be A B C D. Divide each of its sides into

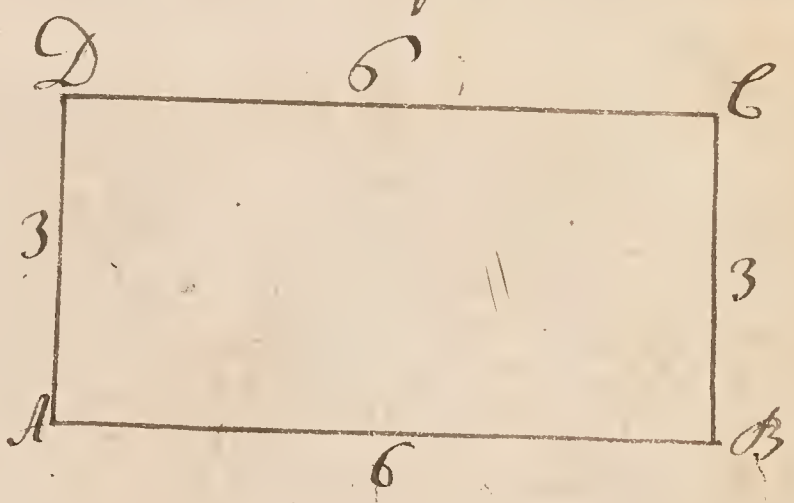
Two

Two equal parts at the Points, F, G, H, I, and draw the right Lines F H & G I, which will cut one another at E; Join with a straight Line H I, and cut off I K equal to I E, and the Remainder H K will be the Radius of each of the Circles. Or, Make the four Lines A P, A 2, C R & C S equal to I H, and draw the right Lines P 2 & R S, which will give you upon the two Lines F H & G I the Centers L, M, N, O. The two Lines P 2 and R S are each of them equal to a side of the Square A B; And the Lines P R & 2 S are each of them equal to the Diameter of the Circles: The Triangles A P 2 & C R S are each of them equal to ¼ part of the given Square, or equal to the Square D I E H. The Area & Circumference of the Square A B C D are equal.



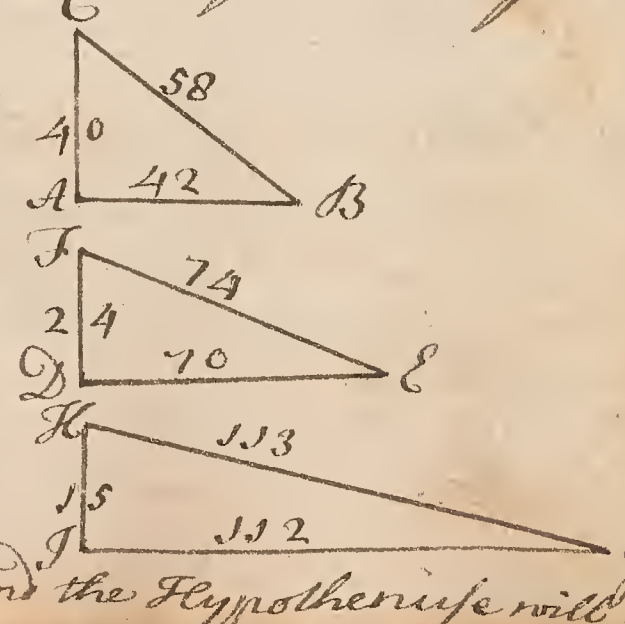
PROB: 10. To describe a Rectangle Parallelogram, the Area of which is equal to the Circumference.

Draw the two perpendicular Lines A B & A D, the first to contain three parts, & the other Six draw also 2 Parallel Lines B C & D C, and you have the Oblong Square A B C D, the Area & Circumference of which are each of them equal to 36 parts. In Integers we have only this Rectangle, & the Square of 4, that are of this Quality: But in any Fractions there are many; To find which, fix upon the side A B what Number you please, only it must be larger than 2, suppose then 8, divide its double 16 by the same side wanting 2, viz 6, and the Quotient $\frac{8}{3}$ is the other side A D, which has for its length 8, for its breadth $\frac{8}{3}$, & for either its Circumference or Area $\frac{64}{3}$ or $21\frac{1}{3}$.



PROB: 11. To describe three different Rectangle Triangles with equal Areas.

From a Scale of equal parts take the Base A B of 42 parts, & the Perpendicular A C of 40, then B C the Hypothenuse of the first Triangle A B C will be 58 parts; as appears by adding 1764, the Square of the Base A B, to 1600 the Square of the Perpendicular A C, & extracting the Square Root out of the Sum 3364. Then lay down D E the Base of the 2d right Angle Triangle of 70 parts, & the perpendicular D F of 24, and the Hypothenuse will be

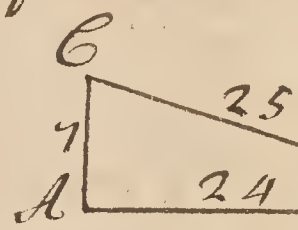


found to be 74. Thus, the Area of the second right Angle Triangle D E I will be equal to that of the first, each being 840; as appears, by multiplying the Base by the height & halfing the Product. Lastly, Take I G the Base of the third Rectangle Triangle I G H 112 parts, the Altitude or Perpendicular I H 35, then the Hypothenuse H G will be 113 parts, & the Area of this third Triangle likwise 840.

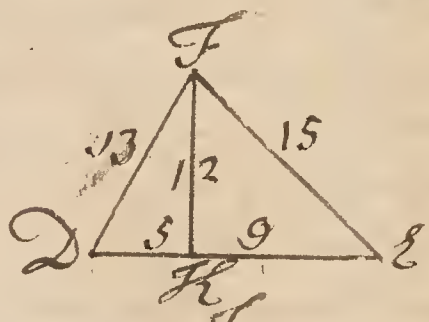
To find the generative Numbers of the three foregoing Triangles, you must add the Product of any two Numbers to the Sum of their Squares and you have the first, the difference of their Squares is the 2, and the Sum of their Products & of the Square of the least is the 3d generative Number; if of the three Numbers thus found you form three Rectangle Tri=angles, viz: one of the two first, another of the two extremities, & a 3d of the 1st & the Sum of the other 2, these 3 Rectangle Triangles will be equal to one another.

Prob: 12. To describe three equal Triangles, the first of which shall be Rectangled, the 2d an Oxygonium, & the 3 an Amblygonium.

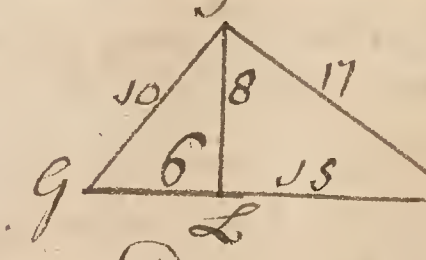
From a Scale of equal Parts take A B, the Base of the Rectangled Triangle A B C, of 24 Parts, and the Altitude A C of 7 Parts, and then the Hypothenuse B C will be 25.



Then upon D E, the Base of the Acute Angled Triangle D E F, take Segment D K of 5 parts & the Segment K E of 9 parts, & from the Point K upon the Base D E, raise the Perpendicular K F of 12 parts, & then the side D F will be found 13, & the other side will be 15 parts.

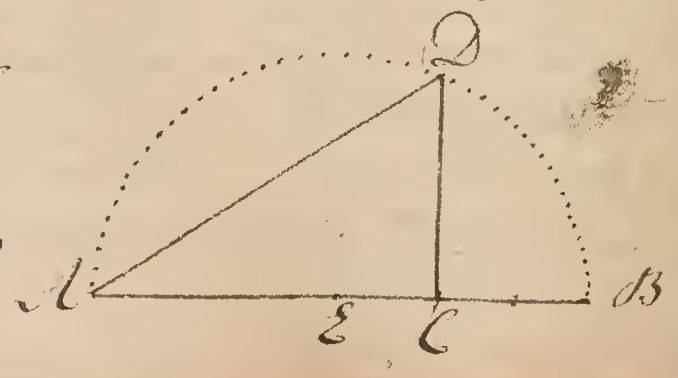


Lastly, upon G H, the Base of the Obtuse Angled Triangle G H I, take the Segment G L of 6 parts & the Segment L H of 13, and from the Point L upon the Base G H, raise the Perpendicular L I of 8 parts, & the side G I will be found, & the side H I 17 parts, as by former Operations

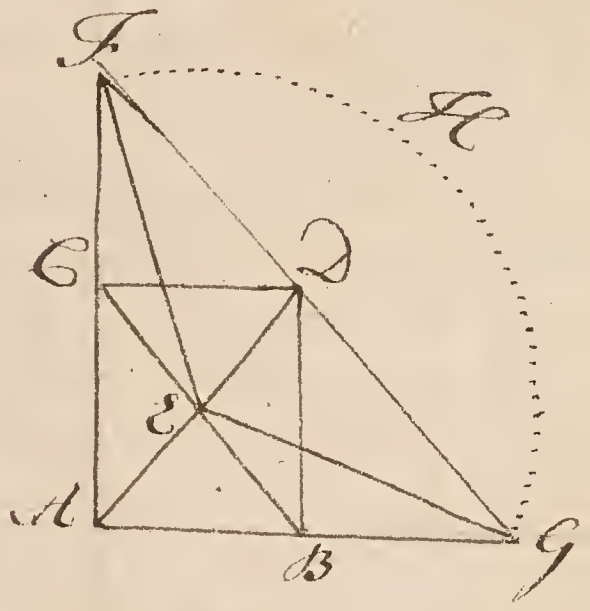


Prob: 13. To find 1, 2, or 3 mean Proportionals to two Lines given.

To find in the first place one Proportional between the two Lines given A B & A C describe round the greatest A B the Semi=circle A B D & from the end of the least A C raise the Perpendicular C D and draw the line A D, it is a mean Proportional between the two Lines A B and A C.



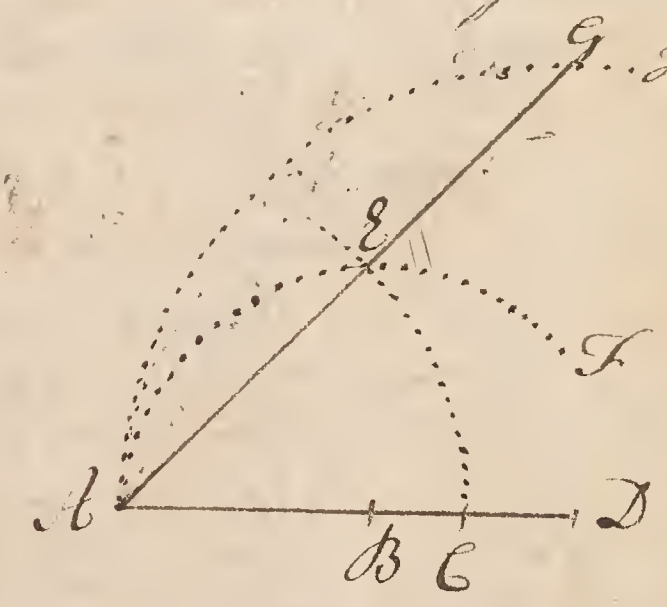
To find two means continually Proportional between two gi=
=ven Lines. Let A B & A C be the two given Lines; Make
of these two Lines the Rectangle Parallelogram A B D C, from
it's Center E describe the Quarter of
a Circle G H F of such a bigness that
the right Line F G, drawn through
the 2 Points where the curve cuts the
two Lines A B & A C, prolonged passes
by the right Angle D; & these two Lines
C F & B G will be the mean Propor=
=tional Enquired for; & the four Lines
A B, C F, B G and A C will be con=
=tinually proportional.



If the two Lines A B & A C were
given in Numbers, as if A B were 32 & A C 2, we may expresse in
Numbers the 3 Means A F, A D, A G by multiplying together
32 & 2 the two Numbers of the two given Lines, & taking the Square
Root of the Product 6, viz 8, for the Mean A D, which being mul=
=tiplyed by A C the first, & A B the last seperally, the Square Root
of the two products 16 & 256 make 4 for A F & 16 for A G.

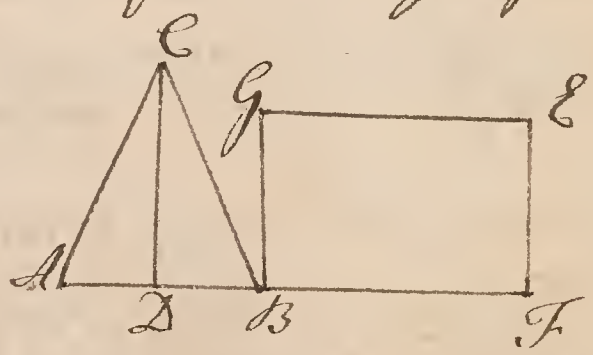
Prob: 14. To find a 4th Proportional Line to 3 Lines given.

Let the three given Lines be A B,
A C, A Z. Upon the two extremities,
B, Z, of the first & 3d Lines given De=
=scribe from the common Extremetie,
A, the two Arches of a Circle A E F &
A G H, & having applyed to the first
Arch, A E F, the Line A E equal to the
second Line given A C, prolong y Line
A E till it meet the 2d Arch A G H in
some Point as in G, then will the
whole Line A G be the 4th Proportional Line required.



Prob: 15. Upon a Line given to describe a Rectangle Paral=
=legram, the Area of which is y double of that of a Triangle given.

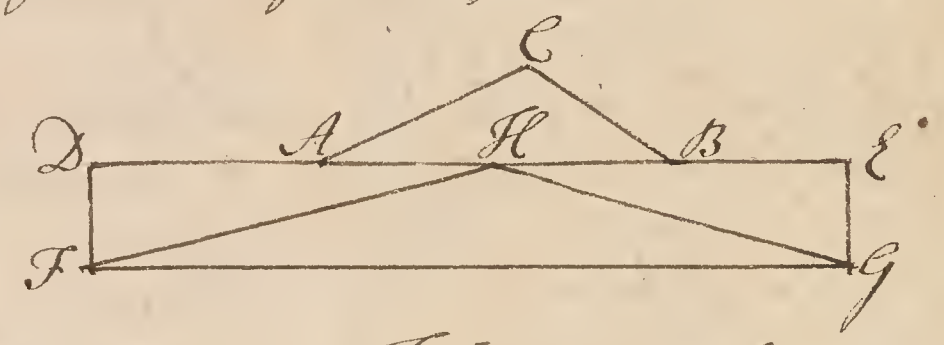
Let the Triangle given be A B C,
& the Line given B F. draw F E perpen=
=dicular to the given Line, & a 4th propor
=tional to the Line given B F, the Base
A B of the Triangle given A B C, and
the height of it C D; then finish ye Rect=
=angle B F E G, which solves the Problem.



Prob: 16

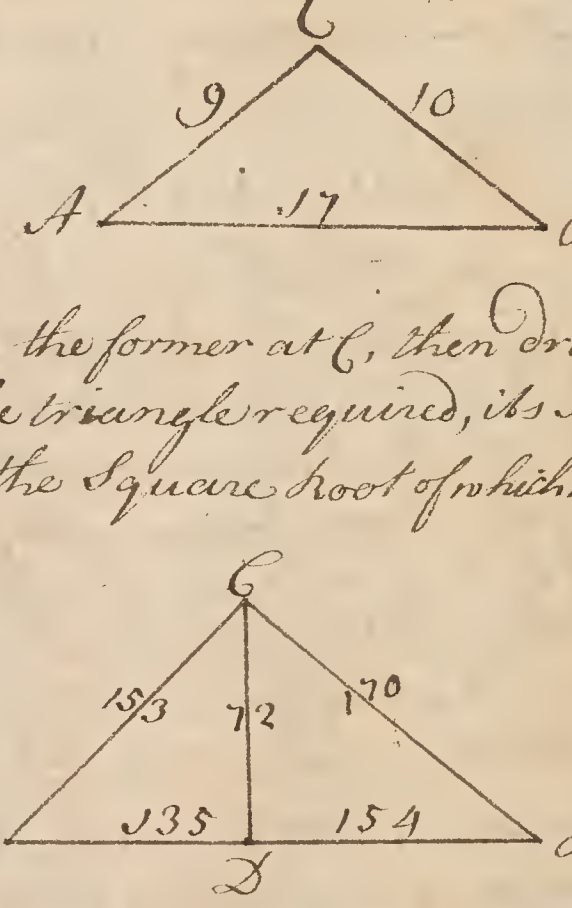
Prob: 16. To change a Triangle given into another Trian=gle of an equal Area, each side of which is greater than each side of the Triangle given.

If the Triangle given be A B C, prolong its Base A B on both sides to D & E, so that the Line A D may be equal to side A C, the Line B E to the Side B C, & by the forgoing Prob: Describe upon the Line D E the Rectangled Paltalegram D E: G F the double of the Triangle given A B C; that done, take upon the Line D E, between the Points A B a point at discre=tion, such as H, from which draw to the 2 Angles F & G the right Lines F H & G H: thus you have the Triangle F G H equal to the proposed Triangle A B C, each of them being the Half of the Rectangle F G E D, & each of the sides of the one be=ing greater than each of the sides of the other, which was to be done.



Prob: 17. To Describe a Triangle, the Area & Circumference of which are one Square Number.

Take from a Scale of equal parts 17 for the Base A B, from the extreamitie of which A, with the Aperture of 9 parts, describe an Arch of a Circle, & from the extremitie B, with the Aper=ture of 10 parts, describe another Arch cutting the former at C, then draw the Straight Lines A C & B C; So is A B C the triangle required, its Area and Circumference being each of them 36, the Square Root of which is 6.



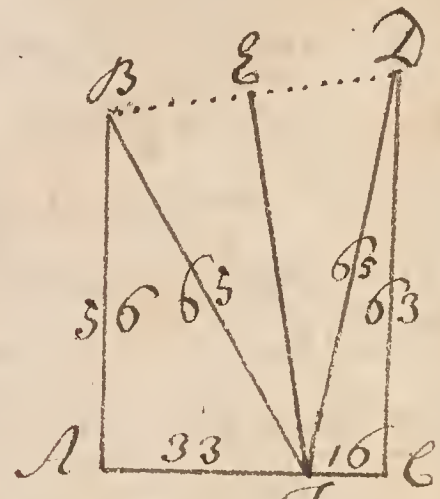
This Triangle hath been found in Numbers by the Means of these two Numeral right An=gled Triangles of the same height 72, 135, 153, and 72, 154, 170, the Generating Num=bers of which are 12, 3, and 11, 7, by joining together these two right Angled Triangles, in order to have the Oblique Angle Triangle A B C, the height of which 72 C D, the Base 289 But & by dividing each side by the Square Root 17 of that Base 289.

Prob: 18. Two lines being given perpendicular to one Line drawn thro' their extremities, to find upon that Line a Point equally removed from each of the two other extremities.

Given the two Lines A B & C D perpendicular to the Line A C which passes through the extremities A & C, you'll find upon that Line A C the Point E equally removed from the two other extremities B and D, by joining these two extremities with the right Line B D, and drawing from E, the middle point of that Line, the

Per=

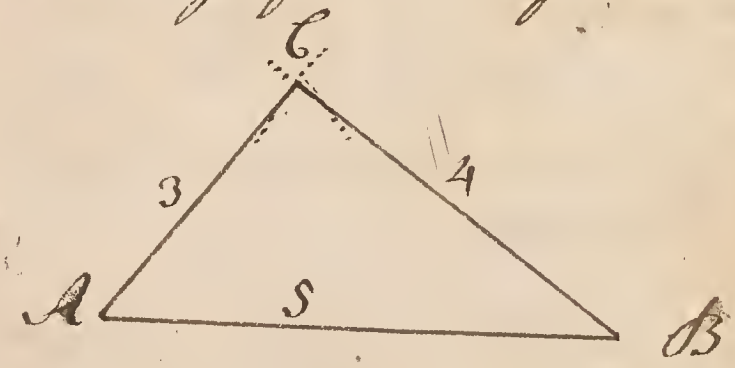
Perpendicular E F which will mark out upon A C the Point F required, the two Lines F B & F D being equal.



This Problem is often proposed after the following manner. The heights A B & C D being given & their distance A C, to find upon the Ground A C a point F from & the Ropes extended to the Tops B, D shall be equal. When the height A B & C D and their distance A C are known in Numbers, as if the height A B were 56 Foot, & C D 63 Foot, & the distance A C 49 Foot, the part A F is found by taking from the Sum of the two Squares A C & C D the Square A B, & dividing the remainder by the Double of A C; and in like manner, the Part C F is found by Subtracting from the Sum of the two Squares A C & A B the Square C D, & dividing the remainder by the Double of A C. Thus the part A F will be found to be 33 Foot, & C F 16 Foot, and each of the two equal parts F B & F D 65 Foot, as is easily computed by adding the two Squares A B & A F, or the two Squares C D & C F, and extracting the Square Root out of the Sum 4225.

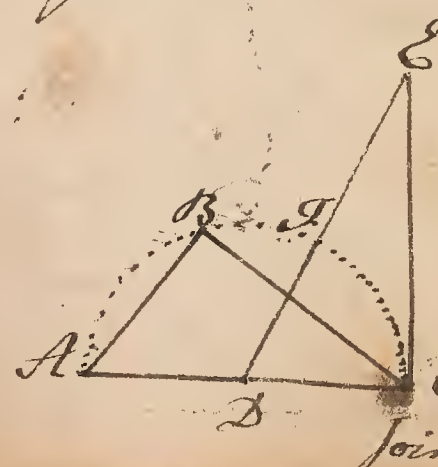
PROB: 19. To Describe a Rectangle Triangle, the three sides of which are in Arithmetical Proportion.

Take the indefinite Line A B, and mark upon it 5 equal Parts of what length you will from A to B, and let this determined Line be the Hypothenuse of the right Angle Triangle. From the Extremitie A, at the interval of 3 of the parts, describe an Arch of a Circle, & from the extremitie B at the distance of 4 parts, describe another Arch which will cut the first at the Point C, and from this Point C if you draw to the two extremities of the Hypothenuse A B the right lines A C & B C, you have a Rectangled Triangle A B C the three sides of which B C, A C, & A B are in Arithmetical Proportion, i, e, they rise equally above one another in length. 6, 8, 10 is another Triangle of the same sort.



PROB: 20. To Describe a Rectangle Triangle, the three sides of which are in Geometrical Proportion.

Having drawn at pleasure the Semicircle A B C from the Center D, & of which the Diameter A C shall be taken for the Hypothenuse of the Triangle required, draw from C the line C E equal & Perpendicular to the Diameter A C, &

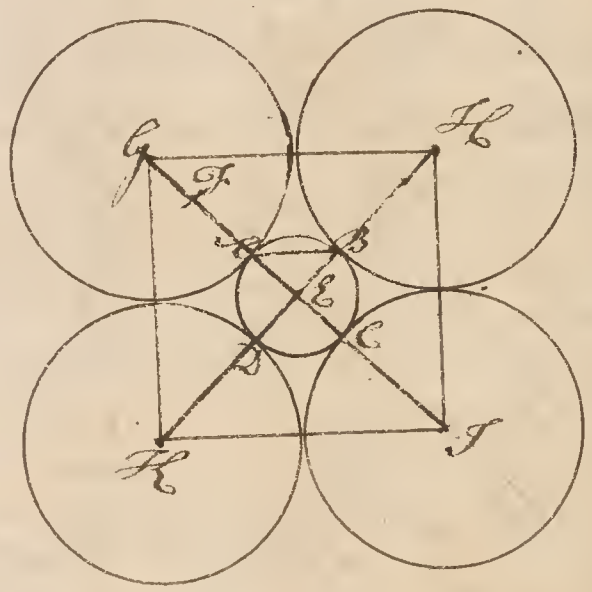


Join the right Line D E which is here cut by the Circumference of the Semicircle at the Point F, take the Length of E F and lay upon the Circumference A B C extending from A to B, and draw the right Lines A B & B C which at the Point B will form a right Angle, & the Rectangle Triangle A B C will be the Triangle enquired for; & so their will be the same Ratio between the Side A B & the Side B C, as there is between B C & the Hypothenuse A C.

PROB: 21. To draw 4 equal Circles that touch one another and the Side of a Circle given.

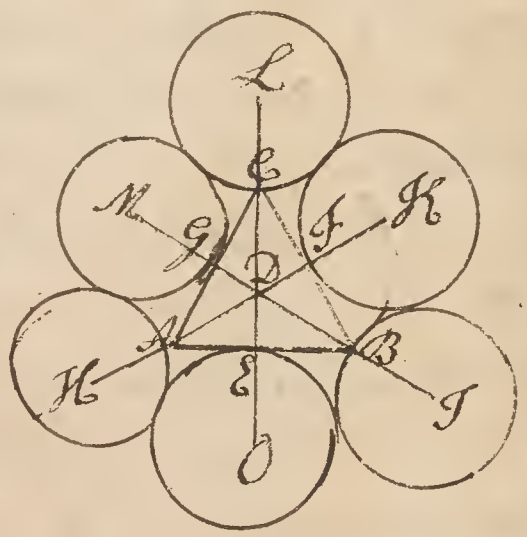
Draw the given Circle A B C D, divide it into 4 parts, & Draw the Chord A B, prolong the Diameter A C to F equal to the Chord A B, take the Distance E F & mark from A to G, and from the Points A, B, C, D with this Distance mark the Centers G, H, I, K, & from them Draw the Circles required.

At the several Points G, H, I, K are two Angles, made by the Diameters of the given Circle prolonged, each being half right Angles, their respective Arches consisting of 45 Degrees.



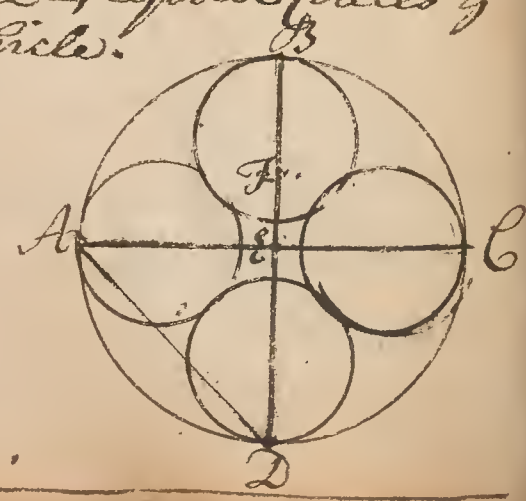
PROB: 22. To describe 6 equal Circles, that mutually touch one another & the 3 Sides & 3 Angles of a given Equilateral Triangle.

Let the Triangle given be A B C & its Center D; From the Center thro' the 3 Angles & the middle of the 3 Sides draw as many right Lines, in order to mark the 6 Centers H, I, K, L, M, O, take the Half of the Side of the Triangle for the Radius of the Circles, as from E to O, from B to I, & from A to H & so proceed to describe the six Circles whose Centers are H, I, K, L, M, O.

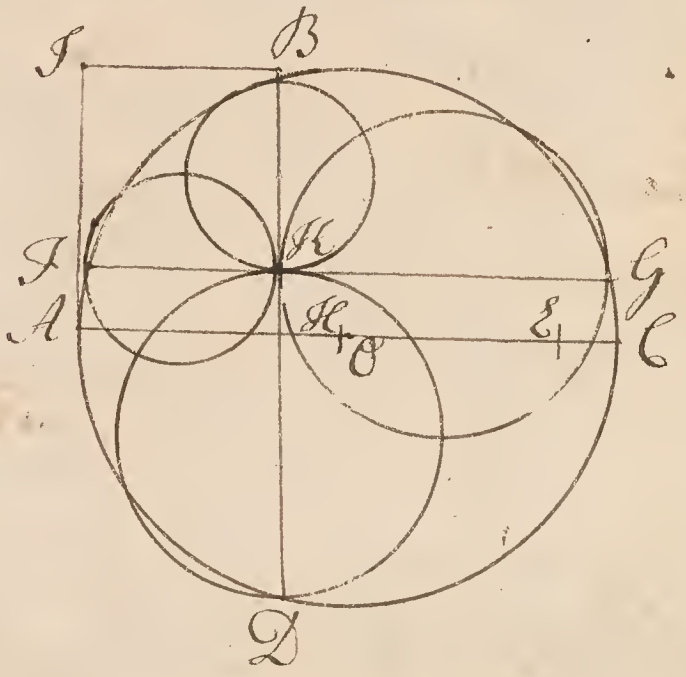


PROB: 23. To Inscribe in a given Circle 4 equal Circles & touch one another & the Circumference of ye given Circle.

The Circle given being A B C D, ye Center of wch is E, divide it in 4 equal parts, upon the Diameter B D take the Line D F equal to the Chord A D, & the Line E F will give ye Length of the Radius of each of the Circles.

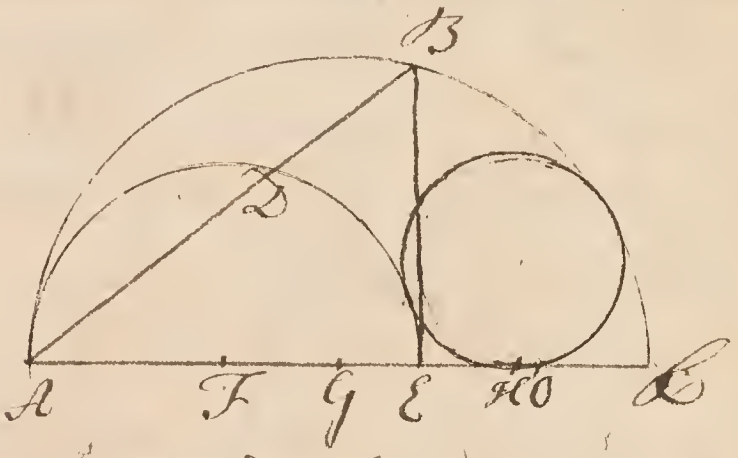


Prob: 24. To Describe four proportional Circles, in such a manner that their Sum shall be equal to a given Circle, & that the Sum of their Radii, be equal to a given Line.



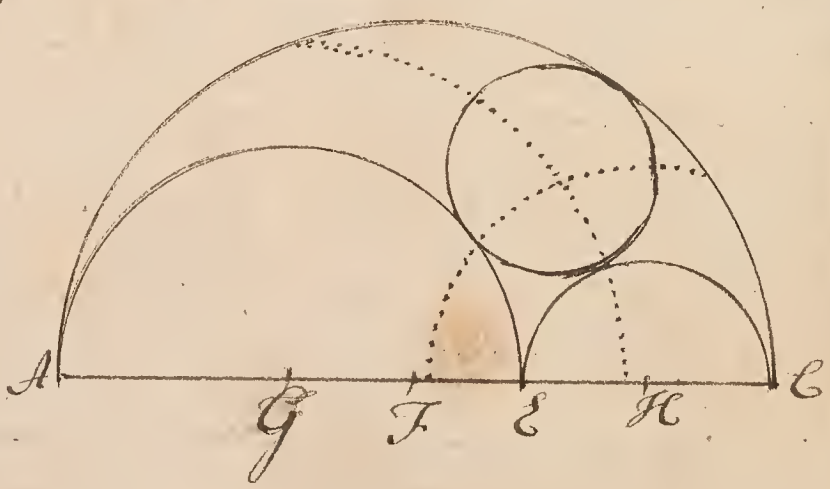
Let the given Circle be A B E D, whose Center is O & the Diameter A C, & the given Line A E. Draw the Line F G parallel to, & what distance you please from, the Line A C; cut the Line A K equal to the half of the Line F G, as at H; erect a Perpendicular on ye Point A the length of A H, & let it be marked A I; Then draw I B parallel to A C, & at the Distance of I O; Lastly, draw B D parallel to I I, and K B, K F, K D, and K G will be the Diameters of the Circles required.

Prob: 25. Two Semicircles upon a right Line being given, to Inscribe a Circle that toucheth the Circumference of the Semicircles and the right Line.

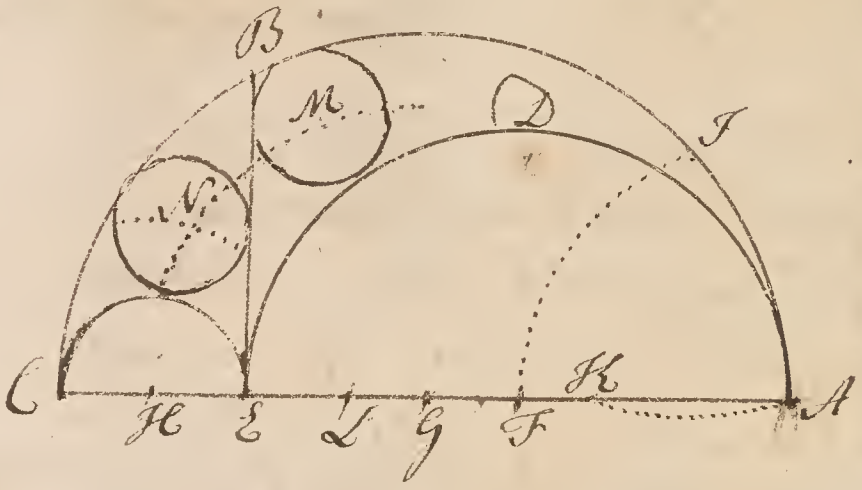


Let the Semicircles given be A B C, & A D E, & the given Right Line A C. Take A G, the half of the Diameter of the biggest Semicircle, and set off from F, the Center of ye lesser Semicircle, to O; erect a Perpendicular at E & draw the Line E B, then draw B A, & set off that distance from A to H, & a 3d Proportional to these 2 Lines E H & E O will be the Radius of the Circle sought.

Prob: 26. To Describe a Circle that toucheth ye Circumference of three Semicircles within a given right Line.

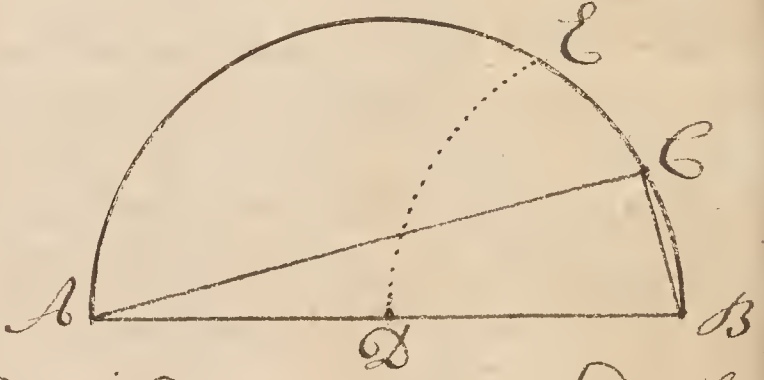


Prob: 27. To Inscribe 2 equal Circles that touch a Perpen=
=pendicular & the Sides of three Semicircles given on a given Line.



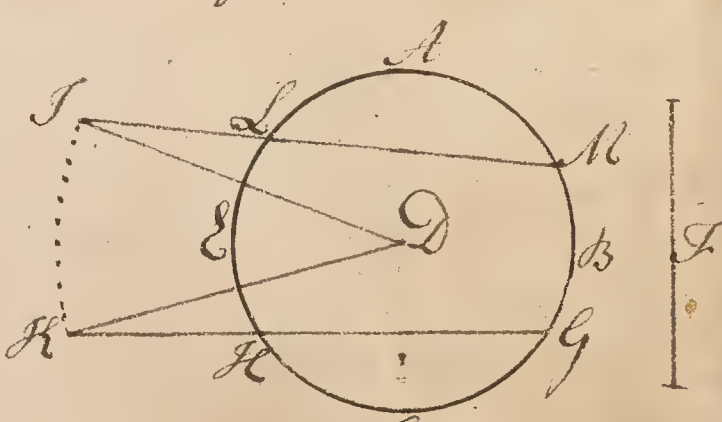
Prob: 28. To Divide the Circumference of a Semicircle given, in such a manner, into two unequal Arches, that the Semidiameter may be a Mean Proportional between the Chords of these two Arches.

If the Semicircle given is A B C, then Center of which is D, Describe from B, thro' D, the Arch of a circle D E, & having Divided the Arch B E into two equal Parts as at C; Draw the 2 Chords A C & B C, between which the Semidiameters A D or B D are Mean Proportionals. Tis evident that the Arch B E contains 60 & it's half B C or C E 30 Degrees, and the other Arch A E C is an Arch of 150, from whence we may conclude, 1st, that the Sinus of an Arch is half the Chord of a Double Arch, and the half of the Radius, or Sinus total, is the Sinus of an Arch of 30 Degrees, This Sinus of an Arch of 30 Deg: is a mean Proportional between the Sinus of an Arch of 15 Deg: or the Sinus of an Arch of 75 Degrees.



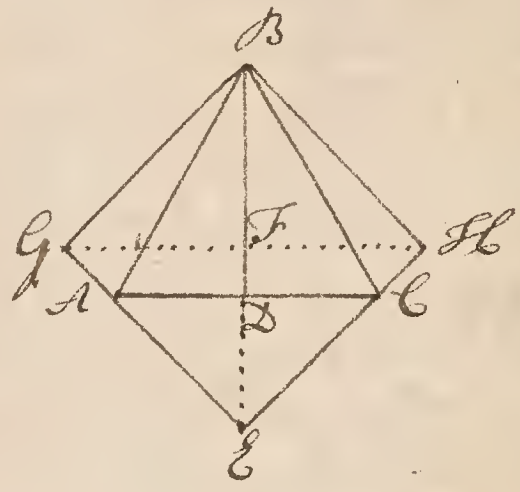
Prob: 29. From a Point assigned to draw a Line to cut off an Arch of a Circle whose Chord shall be equal to a Line given, the said given Line being less than the Diameter of the Circle.

Let A B C E be a Circle given, and I the Point assigned, & F the given Line. Take in your Compasses the Line given F, & set it any where in the Circumference as from G to H, & draw the Line G H prolonged to K; that done, from I draw a Line to the Center D, & keeping one Foot in D in the other, at the distance F, make the Arch K L to cut G H being prolonged in K; that done, take K G in your Compasses, & setting 1 Foot in I with the other cross the Circle in M; lastly, draw the Line I L M, to which



Which cutteth off the Arch L A M whose Chord L M is equal to F the Line given, which was required.

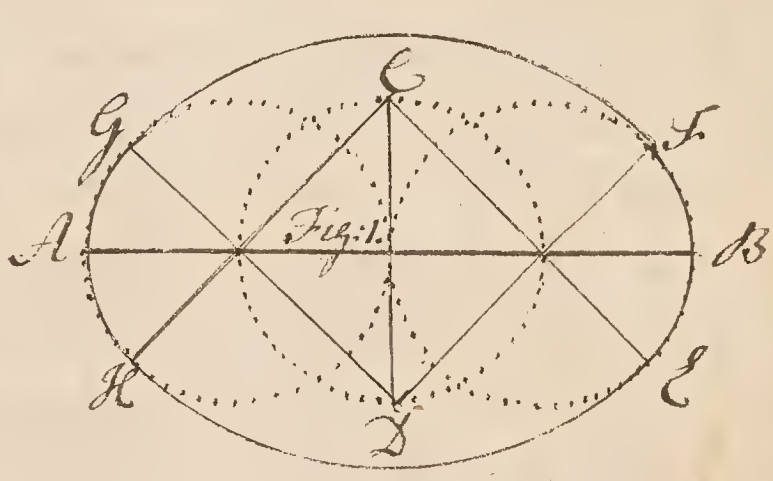
PROB: 30. To make a Geometrical Square to pass by any three given Points.



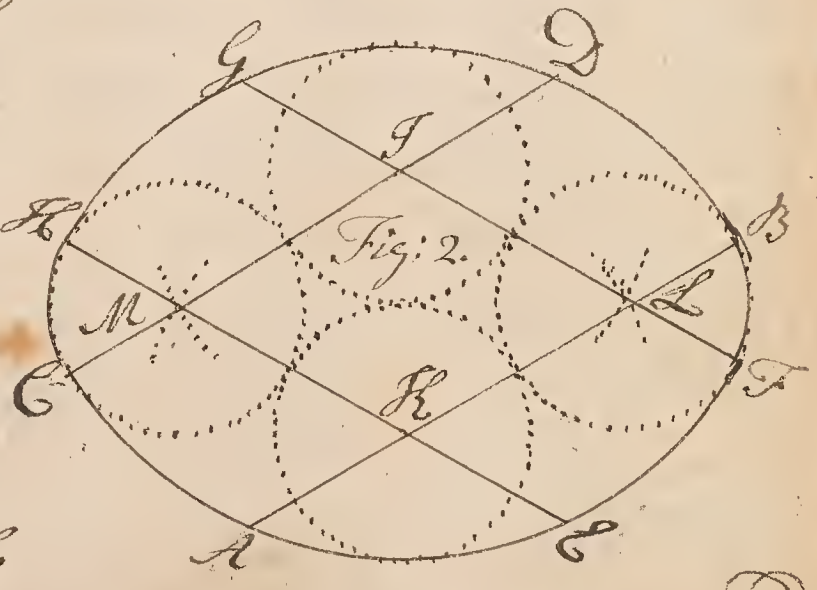
Let A B C be three points given, by which a Geometrical Square is to pass. First draw the Lines A B, B C, & C A inclosing the Equilateral Triangle A B C, then from the Point B let fall a Perpendicular as B D, which increase to E, so that D E may be Equal to D C or D A, the half of the Side A C; that done, divide the whole Line B E into 2 equal Parts at right Angles in F by the Line G H; then set off both ways the half of B E from F to G & to H; lastly, draw the Lines B H, H E, E G, & G B; so shall you have a Square that passes by the Points A, B, C, which was required.

PROB: 31. To make an Ellipsis or Oval several ways.

1st. Make three Circles, whose Diameters may be in a straight Line, as A B, which being divided into 4 Parts each part will be the Radius of the several Circles; cross the said Line with another perpendicular to it at the Center of the middle Circle as C D, & draw the Lines C E, C H, D G, D F; set one Foot of the Compasses in D, & extend the other to G, describe that part of the Ellipsis G F; with the same extent, setting one Foot in C, describe the other part H E; the two Ends are made by the Parts of the two outmost Circles F E and G H.



2ly Draw two Circles, whose Circumferences may only touch each other; then taking the Distance between their Centers, or either of the Diameters, set one Foot of your Compasses in one of their Centers as that marked K, & with the other make an Arch at L & at M, then moving your Compasses to the Center of the other Circle I, cross the said Arches at L & M, which crosses will be Centers for other two Circles of equal bigness wth the first: Then, thro' the Centers of all 4 Circles draw the Lines A B, C D, E H, F G; which done, place one Foot of the Compasses on the Center I, and extending the other to C, Describe the Arch of Ellipsis C E F, and from K describe the Part B D G H, & then is the Ellipsis finished.



3.ly This needs no Description, it being so like the two fore-going Figures & easier than either of them.

N: B: You may make the Ovals according to Fig: 1st & 3d of any determined length: For the length of the 1st there are four Semidiameters of the small Circles, and the 3d but three. If therefor any Line be given, of which length an Oval is required, you must take in your Compasses the fourth part of the Line to make the first, & the third part to make the third Oval; with that extent Describe the small Circles, then make the Ellipsis or Oval as before directed, & the breadth will be always proportionable to the length. But if the breadth be given & the length undetermined, take the fourth part thereof & describe the Ellipsis according to Fig 2d; and the length will be always proportionable to the breadth.

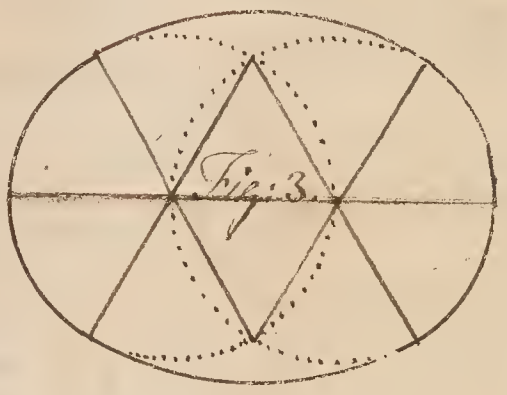


Fig: 3.

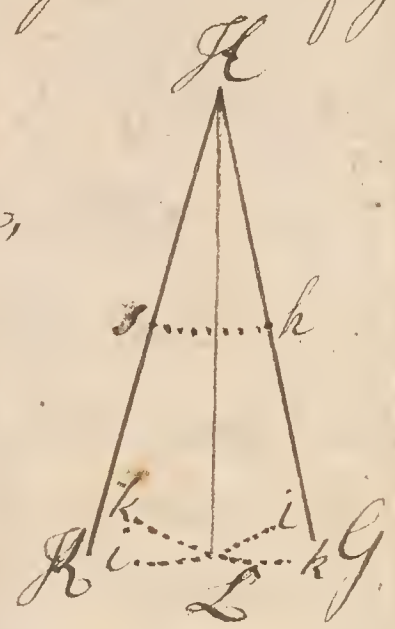
4.ly To make an Ellipsis having length & breadth given.

Let A B be the length, and C D the breadth. First, lay down the Line A B equal to the given length, & cross it in the middle with the Perpendicular C D equal to the given breadth; Take with your Compasses the half of the Line A B, viz: A E or B E, and setting one Foot in C, with the other strike two Arches upon the Line A B viz F and G, also with the same extent set one Foot in D and cross the former Arches at F & G; then with an aperture of the Compasses at any distance less than A E or B E, with one Foot in G with the other make an Arch on both Sides as at K & L, & setting one Foot in A with the same extent mark the Point H in the given Line, then with the distance H B setting one Foot in F cross the former Arches at K and L, which Points of intersection will be in the Ellipsis: Do the same on the other end, i,e. with the distance G K from the Point F strike an Arch on both sides as at M & N, and with the same Extent set on Foot of the Compasses in B with the other mark the point I, then with the distance I A set one Foot in A and cross the Arches M & N; that done, find a Center to the three Points K, C, M, from & describe the Arch of the Ellipsis K C M, do the same for the Points L, D, N, for K, A, L, and for M, B, N, which will finish the Ellipsis.

N: B: The ordinary way used by Gardiners &c to describe Ovals is by fixing two Pins, or two strong Stikes, at the Points G & F then putting a Thread or Cord about them make fast the two ends at such an exact length, that, stretching by the 2 Pins, the bent of the Chord may exactly touch the Points A, C, B, D, so moving it round it will describe an exact Oval.

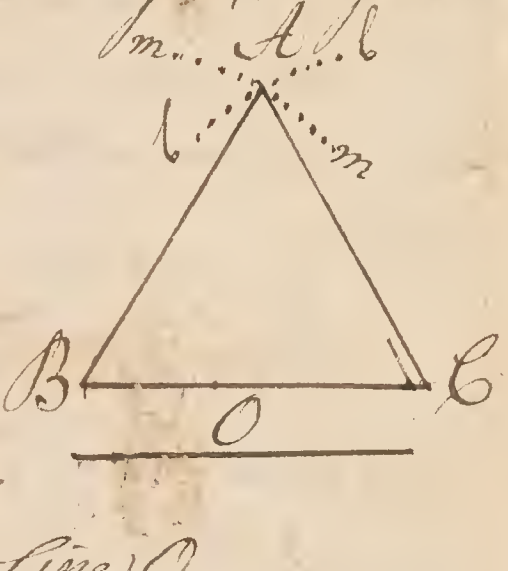
Prob: 32. To divide an Angle into two equal parts.

First, Upon the Angular Point H (wt any Distance of y. Compasses) describe an Arch cutting the two sides, containing the Angle, in the points K and s. The Compasses opned to the same or any other distance, set one Foot in k, and with the other describe the Arch K k; and with the same distance set one Foot in s, and with the other describe the Arch i i crossing k k in the point L. Join H L, and so is the Angle G H K divided into two equal parts by the Line H L.



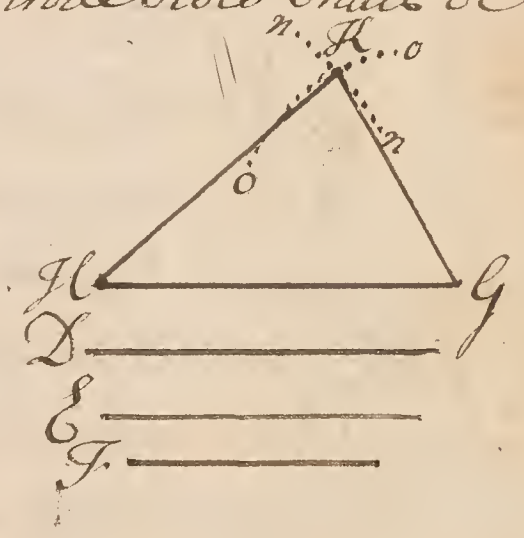
Prob: 33. To make an Equilateral Triangle, whose sides shall be equal to a given Line.

Make the side B C equal to the give Line O, and with the same distance of the Compasses, setting one Foot in B, with the other describe the Arch m m; set also in C and describe the Arch l l crossing the former in A: Then join A B and A C, so have you constituted a Triangle A B C whose three sides are severally equal to the given Line O.



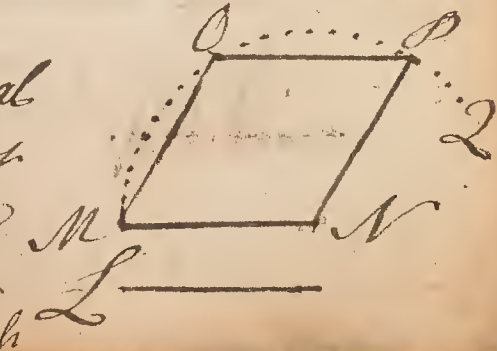
Prob: 34. To make a Triangle, whose three sides shall be equal to three given right Lines.

Make the Line G H equal to the given Line D. Take the given Line E in your Compasses, and setting one Foot in H, with the other describe the Arch n n. Take the Line F in your Compasses; and setting one Foot in G, with the other describe an Arch o o, crossing the former Arch in the Point K. Join G K and H K; so shall you have constituted a Triangle; whose three sides G H, H K, and G K, are equal to the three given Lines D, E, and F.



Prob: 35. To make a Rhombus, whose four sides shall be equal to a given Line.

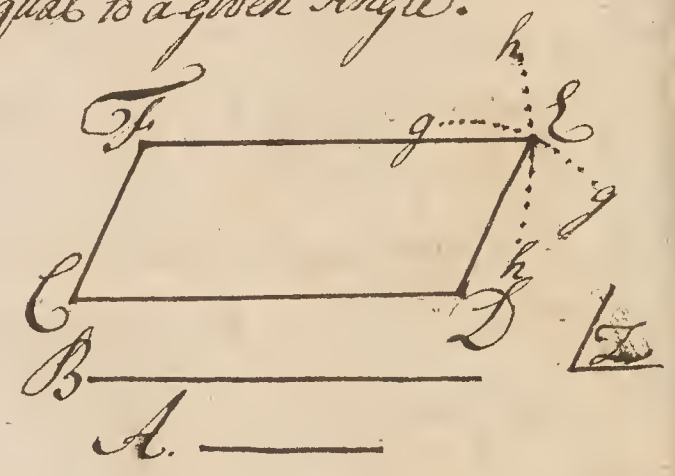
Make M N, (for one side of the Rhombus) equal to the given Line L, & with that Length, set one Foot of the Compasses in N, & with the other describe the Arch M O P 2. Set the same Distance upon this



Arch

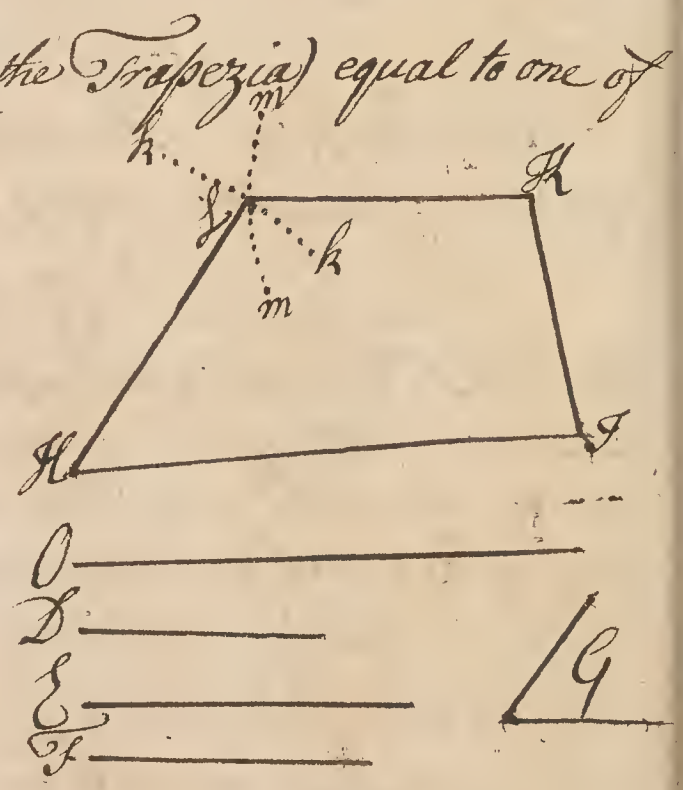
Arch, from N to O, and from O to P. Join M O, O P, & D N, so shall you have constituted a Rhombus, whose four sides are all equal to a given Line.

Prob: 36. To make a Rhomboyades, whose sides shall be equal to two given Lines; and the Acute Angles thereof, equal to a given Angle.



Make the side of the Rhomboyades C D equal to the line B. On the end C, (by Prob: 4 Page 8) make an Angle F C D, equal to the given Angle L; and the side C F equal to the given Line A. Upon the point F, (with the length of the given line B) describe the Arch h h; and upon D, (with the Distance A) describe the Arch g g, crossing h h in the Point E. Join F E & D E, so have you constituted a Rhomboyades, whose sides are equal to the lines A & B, and its Acute Angles C & E, equal to the given Angle.

Prob: 37. To make a Trapezia, (or Figure of four unequal Sides) which shall have one Angle, equal to a given Angle & y^e four Sides equal to four (proper) Right lines given.

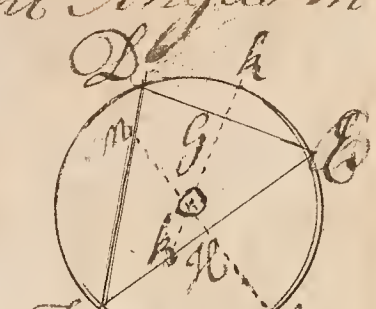


Make the Line H I (for one of the sides of the Trapezia) equal to one of the given Lines, as O. Upon the point I (by Prob: 4 Page 8) make an Angle H I K equal to the given Angle G, making the Side K I equal to the given Line D. Take another of the given lines in your Compasses) as the Line E) and setting one foot upon H, with the other describe the Arch k k; also the 4th given Line F, and setting one Foot of the Compasses in K, with the other describe the Arch m m crossing k k in the point L. Join H L & K L; so shall you have constituted a Trapezia, whose four sides are equal to four given lines, O, D, E, F; & one of the Angles, viz: I, equal to the given Angle G.

Prob: 38. About a Triangle, to describe a Circle.

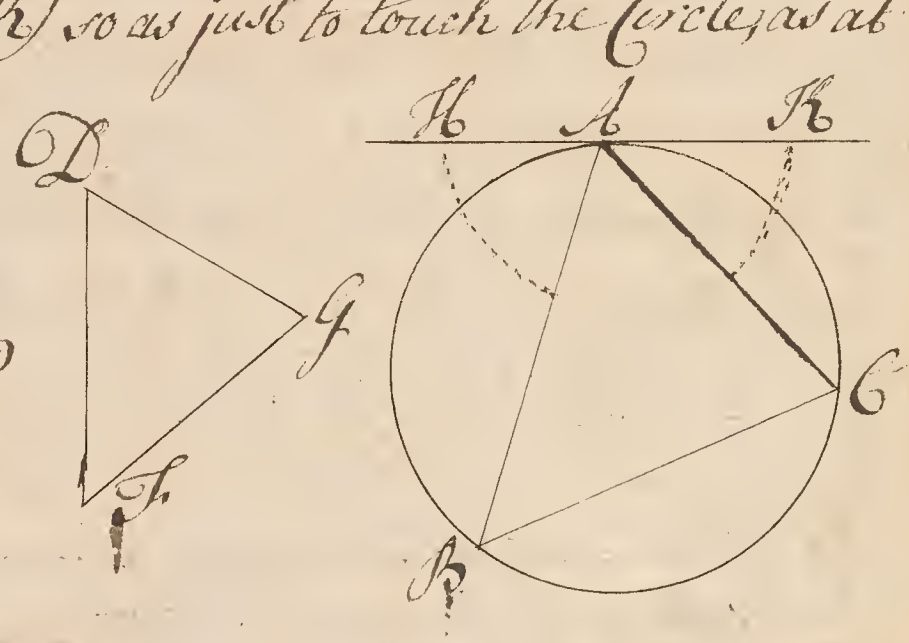
First, (by prob: 1. Page 7) Divide any two of the sides of ye Triangle,

As D E and H F, each into two equal parts, at right Angles in the Points G and K; through which Points the Lines h k and m m being drawn at Right Angles, will cross each other in the Point O, which will be the Center of the Circle.



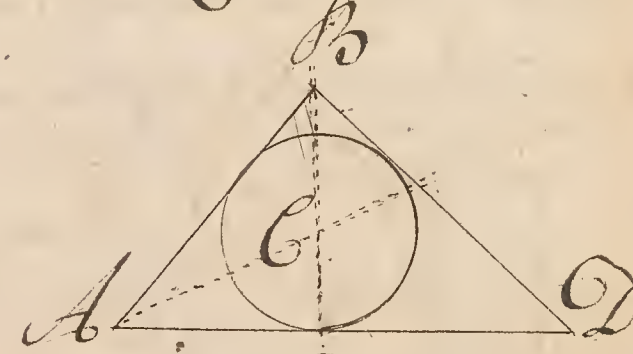
PROB: 39. In a given Circle to inscribe a Triangle, whose Angles shall be equal to the Angles of a given Triangle.

Draw any right Line (as H K) so as just to touch the Circle as at A; then make the Angle K A C equal to any one Angle of the given Triangle, as D F G; and y^e Angle H A B equal to another Angle of the Triangle, as D G F; Then will the Angle B A C be equal to the Angle F D G. Join y^e Points B, C, with a right Line, and it will form the Triangle requir'd.



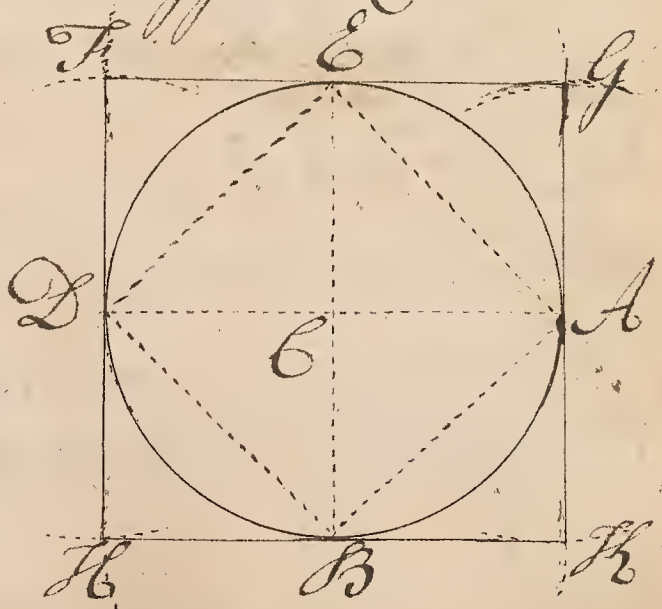
PROB: 40. Within a Triangle to inscribe a Circle.

Let the given Triangle be A B D.
Bisect any two Angles of the Triangle, as A & B, and where the bisecting Lines meet (as at C) will be the Center of the Circle required; and its Radius will be the nearest Distance to y^e sides of y^e Triangle.



PROB: 41. To describe a Square about any given Circle. And to inscribe a Square in a given Circle.

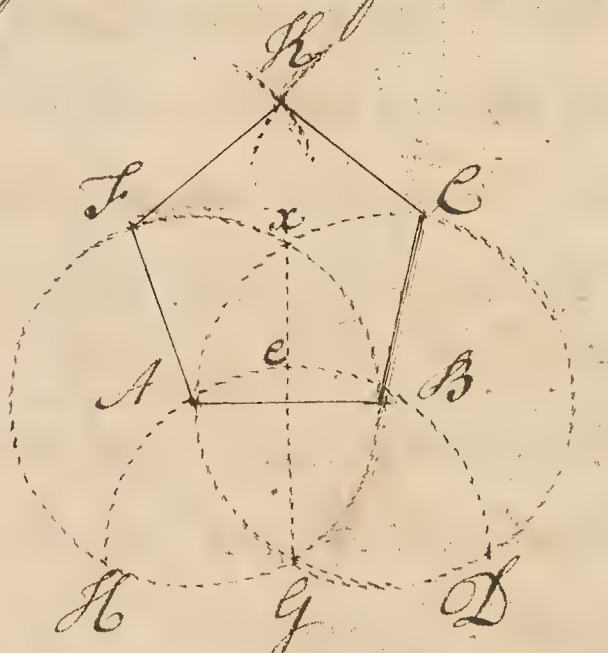
Draw two Diameters in the given Circle (as E A & F B) crossing at right Angles in the Center C; and with the Circles Radius C A, describe from y^e extream Points of those Diameters, A, B, D, E, cross Arches, as F, G, H, K; then join those Points where the Arches cross with right Lines, and they will form y^e Square about the Circle.



Having drawn the Diameters, as D A and E B, bisecting each other at right Angles in the Center C (as in ye Scheme on the fore: going Page); then join the Points A, B, D, and E, with right Lines, viz, A B, B D, D E, E A, and they will be sides of the other Square required.

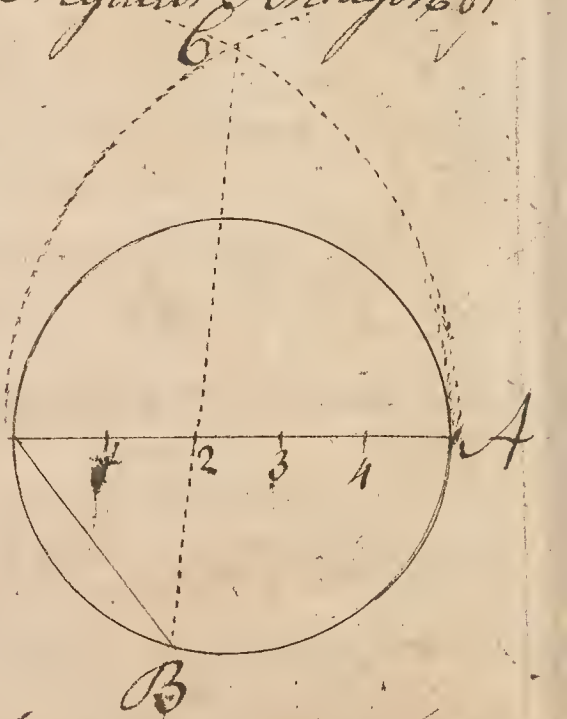
Prob: 42. Upon a given right Line, as A B, to describe a regular Pentagon.

Make the given Line Radius, and upon each end of it describe a Circle; and thro' those points where the Circles cut each other (as at G x) draw the right Line G x: Upon the point G with the same Radius describe a Arch H A e B D, and laying a Ruler upon the points D, e, mark where it crosses the other Circle, as at F. Again, lay the Ruler upon the points H, e, and mark where it crosses the other Circle, as at C: Then from the points F & C (with the same Radius as before) describe cross Arches, as at K: Join the Points A F, F K, K C, and C B, with right Lines, and they will form the Pentagon required, viz, A F = F K = K C = C B = A B; and the Angles at A, B, C, K, F will be equal.



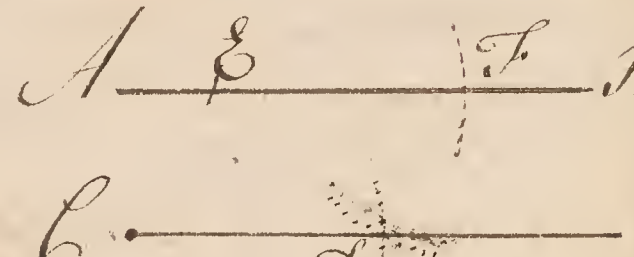
Prob: 43. In any given Circle, to describe a regular Pentagon, or any regular Polygon.

Draw the Circles Diameter D A, and divide it into as many equal parts as the proposed Polygon hath sides; then make the whole Diameter a Radius, and describe the two Arches D C A & C D. If a right Line be drawn from the Point C, thro' the 2d of these equal parts in the Diameter, as 2, it will assign a point in the opposite Semi-Circles Periphery, as at B. Join D B with a right Line, and it will be the side of the Pentagon required.



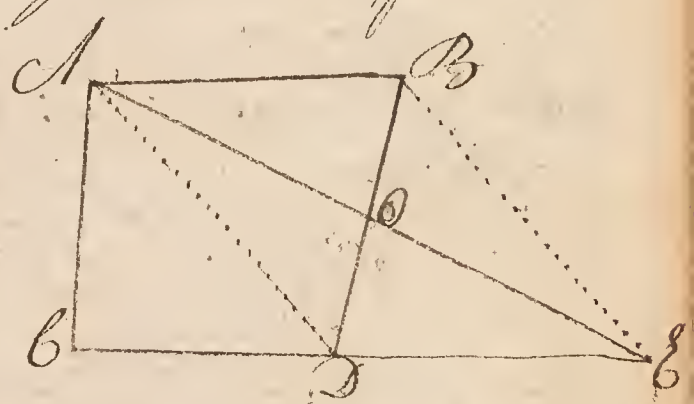
Prob: 44. To make a Line parallel to a right Line given, and through a Point assigned.

Let the given Line be A B, and the point assigned C. Take in the Line A B any point, as E; from the Centers E and C at any distance draw two Circles E F and C D equal; from the Center F with the Distance E C draw a Circle F D, which shall cut the former Circle C D in the point D. Then shall the Line drawn C D be parallel to A B.



Prob: 45. To reduce a Trapezia to a Triangle.

Let the Trapezium be A B C D. — First extend one of the sides as C D, then, having drawn the Diagonal A D, from the Point B draw B E parallel to A D, to cut the Line C D prolonged, in the Point E; lastly lay a Ruler to the Point E & A, & draw the Line A E. So shall the Triangle A C E be equal in Area to the Trapezium A B C D.



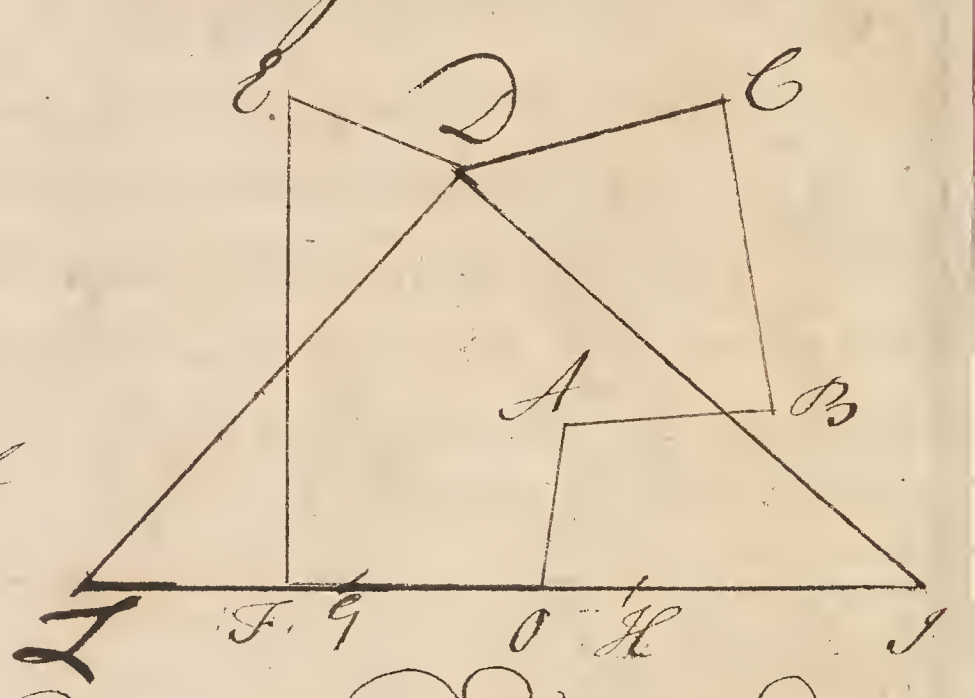
For the Triangles A D E, and A D B, having the same Base A D, and lying between the same Parallels, (by Euc. Lib. 1. Prop. 35) are equal; If from the two equal Triangles A D E and A D B you take away A D O which is common to both, then will remain Tri. A B O equal to the Triangle D O E: Wherefore if the Triangle B O A is left out of the Trapezium A B C D, & the Triangle D O E, taken in, the Area of these two Triangles being equal, it follows, that such an equal Quantity of Space is left out in one part of the Figure as is taken in on the other, & the Area must still be the same: Therefore the Area of the Triangle A C E is equal to the Area of the Trapezium A B C D. Q. E. D.

Prob: 46. To reduce a Many sided Figure to a Triangle of equal Area.

First extend the Line F B, and apply the parallel Ruler to the Points G & B, and move it parallel up to the point A, and where the Edge cuts the Extended

Line

Line F O, make a Mark at G; then lay the Ruler to the Point G and C, and move it up to B and make a Mark in the Extended Line or Base at H.



Lay the Ruler to the points H & D, and move it to C, then make a Prick in the Base at I.

Lay the Ruler to the points D and I and move it up to E, then make a prick in the Base at L.

Lastly draw the Lines D I and D L so shall the seven-sided Figure be reduced to a Three sided Figure L D I whose Area shall be equal; So may the Triangle be cast up at one Multiplication only.

Note, It would have been the same thing instead of laying the Parallel Rule to the Points F & D, you might have layed it to the points I and E & moved it to D so have produced a mark upon the Base; And so have Drawn a Line betwixt that Mark and the Point E and the side E F would have been the other side of the Triangle.

And Observe that we commonly chuse to prolong or extend one of the shortest ~~lines~~ Sides of the Figure to be the Base of the Triangle, as the Side F O.

If you have not a parallel Ruler, do thus, Having produced the Side F O, lay the Edge of a strait Ruler from O to B, then take with a pair of Compasses the Distance from A to the Edge of the Ruler, & with this Distance, set one point of the Compasses move gently Close to the Ruler, while the other traces out a Line parallel to it, and so does F O prolong'd in G, and so on till you have done.

Of Right Angled Triangles in Numbers.

By a Right Angled Triangle in Numbers is meant three unequal Numbers, the greatest of which is such that it's Square is equal to the Square of the other two, such as 3, 4, 5; for 25 the Square of the greatest, which is called the Hypothenuse, is equal to the Sum of 9 & 16 the Squares of the other two Numbers 3 and 4, taking one for the Base the other the height or Altitude. Half the Product of the Base and the Altitude is called the Area, and is likewise divisible by 3. By the Product of the two Numbers is meant the Number arising by their mutual Multiplication. The first and least of all these triangular Numbers is that now mentioned, Viz, 3, 4, 5 which hath this fine property, that the Sum 216 of the Cubes (27, 64, 125) of the two Sides (3, 4) and the Hypothenuse (5) is a Cube, the Root or Side of which (6) is equal to the Area of that Triangle.

1. To find in Numbers as many right Angled Triangles as you will.

Rule. Take any of the two Numbers, such, for Ex:, as 2 & 3, which are called Generating Numbers; multiply them the one by the other, and 12 the double of their Product 6 is the side of a right Angled Triangle, the other side being 5 the Difference of their Squares 4 & 9 (viz, of the Generating Numbers 2 and 3, and the Hypothenuse being 13 the Sum of the same Squares 4 & 9; & thus we have this right Angles Triangle 5, 12, 13: for 169 the Square of the Hypothenuse 13 is equal to the Sum of 25 and 144 the Squares of the two Sides 5 & 12.

The first right Angled Triangle hath this Quality, that the Generating Numbers 1 & 2 hath one for their Difference. And if you want to have another of the same Quality, take 2, the greatest of the first Generating Numbers, for the least of the other two in the Triangle demanded; & in order to find the greatest, add 1, the least of the first, to 4 the double of the greatest, and so you have 5 for the greater Generating Number, which consequently is 20, 21, 29, where the Difference of the two Sides 20 & 21 is again 1. If you desire a 3d Triangle, proceed as before; for the least take 5, and for the greatest double the greater and add the least, which will be 12, and so you'll have the Triangle 119, 120, 169. And by observing this method, you may find a 4th, 5th, or 6th Triangle as appears by this Table.

Hypothenuse.	Altitude.	Base.	Num: Triang.	Gen: Num:	
5	4	3	1	1	2
29	21	20	2	2	5
169	120	119	3	5	12
1025	697	696	4	12	29
5741	4060	4059	5	29	70
33461	23660	23660	6	70	169

The first right Angled Triangle, 3, 4, 5, hath this Quality, That

That the excess of the Hypothenuse above the side 4 is 1, for as much as the Difference of the Gener: rating Numbers is also 1, and for this Reason you may find as many Triangles more as you will of this Quality, if for their Generating Numbers you take two that dif: fer only by unity, as you see by this Table. Here you see the Differ: rence of the Bases 3, 5, 7, 9, &c are

Hypoth:	Alti:	Base	Num: of Trieng:	Gen:	Num:
5	4	3		1	2
13	12	5		2	3
25	24	7		3	4
41	40	9		4	5
61	60	11		5	6
85	84	13		6	7

equal, exceeding each other by 2; & the Difference of the Altitudes 4, 12, 24, 40, &c exceed each other according to the Sum of the foresponding Bases, and the same is the Case of the Hypothenuses 5, 13, 25, 41, &c, which also exceed their foresponding Altitudes by Unity.

Here the Bases are odd Numbers; and if you would have the Square of these odd Numbers, only take the Alti: tude and Hypothenuse for the Generating Numbers of the Triangles you propose, as in this Table.

Hypoth:	Altitude.	Base.	Num of Tri:	Gen:	Num:
41	40	9	1	4	5
313	312	25	2	12	13
1201	1200	49	3	24	25
3281	3280	81	4	40	41
7321	7320	121	5	60	61
14281	14280	169	6	84	85

If you would have the Hypothenuse to be the Square Number, then the Generating Numbers must be the sides of the right: Angled Triangle, as in this Ta: ble where the Hypothenuse is the Square of the greatest Ge: nerating Number with the Addition of Unity.

Hypoth:	Altitude	Base.	Num of Trie:	Gen:	Num:
25	24	7		3	4
169	120	119		5	12
625	527	336		7	24
1681	1519	720		9	40
3721	3479	1320		11	60
7225	6887	2184		13	84

Note, The Right Angled Tri: angle 25, 28, 35 is of this Quality, that the two Sides 25 and 28 are Triangular Numbers the Side of which 6 & 7 differ only by Unity, & the Square of the Hypothenuse 35 viz. 1225, is likewise a Triangular Number the Side of which is 49.

This Table of Right An: gles Trianeles is such, that their Bases & Hypothenuses are Triangular Numbers, and their Height Cubick Numbers.

Hypoth:	Altitude	Base.	Num of Trie:	Gen:	Num:
10	8	6	1	1	3
45	27	36	2	3	6
136	64	120	3	6	10
325	125	300	4	10	15
666	216	630	5	15	21
1225	343	1176	6	21	28

You may find as many Tri: angles as you will, by adding & subtracting a Square Number from its Square; for in ye Addition

Half

Half the Sum is the Hypothenuse, and in subtracting half the Remainder is the Base, the height being equal to the Cube of the Root of the first Square Number. Ex: In the Number 4, adding 4 to 16 is 20 ye half of which is 10 the Hypothenuse, and subtracting 4 from 16 remains 12 the half of which is 6 the Base and the Root of 4 is 2 the Cub of which is 8 the Altitude all which together make the right Angled Triangle 10, 6, 8. By a Triangular Number is understood the Sum of the natural Numbers 1, 2, 3, 4, 5, 6, &c, beginning with an Unit & rising to what height you please, the last of the greatest of which is called the Side. Thus we know that 10 is a Triangular Number, the Side of which is 4, by reason that it is equal to the Sum of the first 4 Natural Numbers. It is called Triangular, because you may dispose its Points in form of an Equilateral Triangle, each Side of which contain 4, and hence it was that 4 got the Name of the Side of the Triangular Number 10.

2. To know if a Number proposed be a Triangular Number.

Rule. Multiply the Number by 8, & add 1 to the Product, for if the Sum be Square, the proposed Number is a Triangular Number. Thus we know that 10 is a Triangular Number, because 81 the Sum of its Multiplication by 8, wth the Addition of 1 is a Square Number having 9 for its Root.

3. To know when a Number is Square, or not Square.

Rule. Every Square Number ends with two Cyphers, or one of the five Figures 1, 4, 5, 6, 9, which serves for a Rule to distinguish when a Number is not Square; Nay, if it doth end with two Cyphers which are not preceded by one of the foregoing five Figures, we may rest assured it is not Square.

4. To know when a Fraction is Square, or not Square.

Rule. Every Fraction that hath its Square Root is such, that the Numerator multiplyed by the Denominator is a Square Number. Ex: The Fraction $\frac{28}{63}$ is Square, because 1764, the Product of y^e Numerator 28 multiplyed by the Denominator 63, is a Square Number having 42 for its Root: and so the Square Root of the Fraction will be $\frac{42}{63}$ retaining the same Denominator, or it will be $\frac{28}{42}$ retaining the same Numerator; for either of these is equivalent to $\frac{2}{3}$ for the Square Root of y^e proposed Fraction $\frac{28}{63}$ or $\frac{4}{9}$.

Astronomers divide the Starry Firmament into three Regions, the middle of which comprehends those Stars which have their situations near the Planes of the Orbits in which the Planets move; this part of Heaven they call the Zodiac, because the Constellations, there placed, seem for the most part to represent some Animal: In this place the Planets are always to be seen, and none of them ever transgress its bounds: upon each side of this Zone lie the other two Regions of the Heavens; one of which is called the North, and the other the South part of the Heavens.

The Names, Latitudes, and Longitudes of which, together with the Number of Stars in each, and their particular Magnitudes, in the British Catalogue, are as follows. — N: B: The first Latitude is South, the other North, unless marked to the contrary.

The Constellations of the Zodiac.

Names.	Long: ° ′	Lat: ° ′	N.°	Magnitude. 1	2	3	4	5	6	7
Aries	♈ 26..48 ♉ 21..06	00..01 12..31	65	0	1	2	5	6	28	23
Taurus	♉ 16..19 ♊ 26..36	18..27 09..46	135	1	1	4	13	21	44	51
Gemini	♊ 14..11 ♋ 12..33	10..07 13..18	79	1	2	4	6	12	32	22
Cancer	♋ 22..49 ♌ 12..19	10..19 14..59	71	0	0	0	6	7	39	19
Leo	♌ 10..57 20..12	07..39 17..38	95	2	2	6	15	10	50	10
Virgo	♍ 00..10 ♎ 29..23	00..24 21..24	89	1	0	5	10	19	45	09
Libra	♎ 04..11 28..35	18..34 N 11..27 S	49	1	2	7	5	11	21	2
Scorpio	♏ 26..28 ♐ 20..26	12..46 N 13..57 S	51	0	2	2	12	5	25	5
Sagittarius	♐ 22..55 ♑ 26..29	10..59 07..31	50	0	1	5	6	11	23	4
Capricornus	♑ 27..26 ♒ 21..29	08..53 07..27	51	0	0	3	3	9	34	2
Aquarius	♒ 07..24 ♓ 21..57	21..04 23..02	99	1	0	4	7	31	50	6
Pisces	♓ 11..06 ♈ 20..17	23..06 09..05	109	0	0	1	6	27	54	21

The Constellations of the Northern Hemisphere.

Names.	Long: ° ′	Lat: ° ′	N°.	Magnitude. 1	2	3	4	5	6	7
Andromeda	♈ 03 .. 29 ♓ 18 .. 04	15 .. 55 49 .. 53	66	0	3	2	12	13	34	2
Aquila cum Antinoo	♑ 29 .. 16 ♒ 08 .. 06	10 .. 05 43 .. 27	70	1	0	10	7	15	32	5
Anser cum Vulpe	♑ 20 .. 20 ♐ 01 .. 14	37 .. 39 47 .. 46	34	0	0	0	4	12	18	0
Auriga	♊ 11 .. 22 ♋ 12 .. 30	02 .. 29 32 .. 13	68	1	2	1	10	18	31	5
Bootes	♍ 22 .. 34 ♎ 00 .. 54	25 .. 15 60 .. 33	55	1	0	8	10	11	17	8
Cassiopeia	♈ 21 .. 06 ♊ 08 .. 04	38 .. 18 59 .. 53	56	0	0	5	7	9	30	5
Camelopardus	♊ 10 .. 40 ♋ 10 .. 39	29 .. 24 45 .. 43	58	0	0	0	4	18	27	9
Cepheus	♈ 00 .. 39 ♉ 26 .. 37	59 .. 32 75 .. 27	35	0	0	3	7	8	14	3
Coma Berenices	♍ 16 .. 53 ♎ 24 .. 38	15 .. 14 33 .. 56	40	0	0	0	8	14	14	4
Corona Septentrionalis	♏ 00 .. 58 20 .. 54	44 .. 21 56 .. 25	21	0	1	0	6	8	6	0
Cygnus	♑ 20 .. 55 ♐ 23 .. 17	37 .. 39 74 .. 10	107	0	1	6	21	31	48	0
Delphinus	♒ 08 .. 49 16 .. 31	23 .. 00 33 .. 44	18	0	0	6	0	2	9	1
Draco	Per totum Circum.	57 .. 13 87 .. 25	49	0	1	7	8	18	19	1
Equuleus	♒ 14 .. 12 21 .. 07	20 .. 09 25 .. 13	10	0	0	0	4	1	5	0
Hercules	♎ 28 .. 07 ♐ 28 .. 29	25 .. 15 69 .. 33	95	0	0	11	15	31	38	0
Leo Minor	♌ 29 .. 08 ♍ 04 .. 04	09 .. 21 30 .. 50	53	0	0	1	5	11	33	3
Lacerta	♐ 19 .. 49 20 .. 27	43 .. 12 55 .. 34	16	0	0	0	3	6	7	0
Lynx	♊ 28 .. 24 ♋ 09 .. 45	17 .. 03 40 .. 39	44	0	0	0	3	12	21	8
Lyra	♑ 03 .. 35 26 .. 14	54 .. 28 66 .. 13	21	1	0	2	2	5	11	0
Perseus C: M:	♉ 08 .. 08 ♊ 10 .. 18	11 .. 17 41 .. 13	67	0	2	5	11	15	28	6
Pegasus	♒ 23 .. 37 ♓ 07 .. 17	09 .. 13 44 .. 24	93	0	4	3	10	13	58	5
Sagitta	♑ 20 .. 00 ♒ 08 .. 37	35 .. 35 43 .. 15	23	0	0	0	4	1	18	0
Serpens Ophiuchi	♏ 07 .. 38 ♑ 11 .. 31	07 .. 59 12 .. 28	59	0	1	7	6	3	32	10
Scutum	♑ 00 .. 23 10 .. 08	04 .. 59 18 .. 17	7	0	0	0	2	4	1	0
Serpentarius, or Ophiuchus	♏ 27 .. 58 ♑ 01 .. 29	06 .. 54 37 .. 18	69	0	1	7	15	13	26	7
Triangulum	♉ 00 .. 05 13 .. 15	13 .. 55 20 .. 34	15	0	0	0	3	1	7	4
Ursa Major	♊ 10 .. 41 ♎ 06 .. 58	17 .. 06 61 .. 03	215	0	6	5	35	58	91	20
Ursa Minor	♊ 26 .. 43 ♌ 27 .. 19	65 .. 42 77 .. 50	24	0	0	4	3	5	6	6
Canes Venatici	♍ 10 .. 05 25 .. 43	52 .. 52 33 .. 56	25	0	1	0	2	5	14	3

The Constellations of the Southern Hemisphere.

Names.	Long: ° ′	Lat: ° ′	N°.	Magnitudes: 1	2	3	4	5	6	7
Ara cum Thuribulo...	♐ 15..06 27..18	23..05 37..15	9	0	0	1	6	2	0	0
Argo or Navis.....	♋ 24..57 ♌ 14..02	22..24 49..14	25	0	0	4	6	6	9	0
Apus.....	♐ 09..45 21..24	44..32 62..04	11	0	0	0	4	3	4	0
Canis Major.....	♊ 03..07 ♋ 23..12	34..44 59..14	32	1	7	1	4	11	5	3
Canis Minor.....	♋ 16..48 ♌ 00..49	09..45 23..47	15	1	0	1	0	3	9	1
Cetus.....	♓ 18..36 ♉ 14..30	02..42 34..14	78	0	2	6	13	9	44	4
Centaurus cum Lupo	♎ 25..42 ♏ 28..30	11..28 24..59	13	0	1	0	5	6	1	0
Camelopardus.....	♏ 26..30 ♐ 03..39	63..35 76..24	10	0	0	0	0	9	1	0
Columba Noahi....	♊ 14..54 ♋ 06..46	65..42 60..41	10	0	2	0	1	6	1	0
Corona Australis....	♑ 01..18 10..14	12..28 22..36	12	0	0	0	1	3	8	0
Corvus.....	♎ 06..26 13..03	10..21 21..44	10	0	0	3	2	2	3	0
Crater.....	♍ 19..26 ♎ 03..58	11..18 22..42	11	0	0	0	8	2	2	0
Eridanus.....	♈ 16..38 ♊ 11..15	18..26 54..33	68	0	0	12	15	20	20	1
Grus.....	♒ 14..54 18..02	39..43 41..55	13	0	0	0	2	1	0	0
Hydrus.....	♑ 26..59 ♈ 03..37	64..10 78..05	10	0	0	4	2	3	1	0
Lepus.....	♊ 06..44 28..09	34..45 45..46	19	0	0	3	7	3	6	0
Musca.....	♍ 16..20 22..22	55..11 58..47	4	0	0	0	2	2	0	0
Monoceros.....	♊ 29..34 ♌ 28..50	13..13 31..11	19	0	0	0	10	7	2	0
Orion.....	♊ 07..32 ♋ 15..11	3..11 34..04	80	2	4	4	25	20	25	0
Pavo.....	♐ 24..07 ♑ 24..41	36..11 50..49	14	0	1	3	5	4	1	0
Phœnix.....	♒ 29..47 ♓ 24..14	31..39 55..05	13	0	1	5	6	1	0	0
Piscis Volans....	♎ 11..19 ♍ 14..11	67..52 82..35	8	0	0	0	0	7	1	0
Robur Carolinæ...	♎ 03..34 ♍ 07..06	51..02 72..12	12	0	1	2	7	2	0	0
Sextans.....	♌ 19..59 ♍ 13..05	01..21 19..43	41	0	0	0	1	7	32	1
Toucan.....	♒ 03..16 22..43	45..27 59..46	9	0	0	4	2	3	0	0
Triangulum.....	♈ 05..35 17..02	41..32 48..01	5	0	1	2	0	2	0	0
Xiphias.....	♈ 07..36 ♉ 18..32	70..12 88..14	6	0	0	1	2	1	2	0
				0						

	Nº	1	2	3	4	5	6	7
Stars in the Zodiac.....	943	7	11	43	94	169	445	174
In the Northern Hemisphere	1511	4	23	93	227	356	695	113
In the Southern Hemisphere..	547	4	20	56	136	145	176	10
Sum of all the Stars.....	3001	15	54	192	457	670	1316	297

Without the Compass of the Constellations or Images, there are several Stars, which cannot be reduced to any of the Forms mentioned; and those are called unformed Stars, out of which some great Astronomers have made new Constellations, as Charles's Heart, &c.

The Galaxy, or Milky way, is also to be reckoned among the Constellations; this is a broad Circle of a whitish hue like Milk; in some places it is double, but for the most part it consists of a single path, and goes round the whole Heavens. The great Galileo, with his Telescope, discovered that the portion of the Heavens which this Circle passes through, was every where filled with an infinite multitude of exceeding small Stars; which tho' they cannot, by reason of their smallness, be seen distinctly by the naked Eye, yet with their Light they all combine to illustrate that Region of the Heavens where they are, and diffuse through it a shining Whiteness.

In this Table, the Letters c. d. signify continual Day without Night — c. n. Continual night without Day, and W. N. Twilight the Whole Night. It is calculated on the Supposition, that Twilight begins & ends when the Sun is 18° below the Horizon, without taking into the consideration the Density or Height of the Atmosphere, which varies the length of Twilight at different times, Seasons, & Latitudes, as doth likewise does the Sun's Atmosphere, or luminous or burning Ether wch he is encompassed, & rises before the Sun, and sets after him.

A Table of the Duration of Twilight in different Latitudes.

Alt. Pole.	0	10	20	30	40	45	50	52½
☉ Enters.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
♋	1..18	1..21	1..28	1..41	2.. 8	2..39	W. N.	W. N.
♊ ♌	1..16	1..19	1..25	1..36	1..58	2..19	3.. 5	W. N.
♎ ♍	1..13	1..15	1..20	1..28	1..43	1..55	2..12	2..25
♈ ♎	1..12	1..13	1..17	1..24	1..35	1..44	1..55	2.. 2
♓ ♏	1..13	1..14	1..18	1..24	1..35	1..43	1..54	2.. 0
♒ ♐	1..16	1..17	1..21	1..28	1..40	1..49	2.. 1	2.. 8
♑	1..18	1..19	1..23	1..30	1..43	1..53	2.. 6	2..15

Alt. Pole.	55	60	65	70	75	80	85	90
☉ Enters.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
♋	W. N.	W. N.	W. N.	c. d.	c. d.	c. d.	c. d.	c. d.
♊ ♌	W. N.	W. N.	W. N.	c. d.	c. d	c. d.	c. d.	c. d.
♎ ♍	2..41	3..55	W. N.	W. N.	W. N.	c. d.	c. d.	c. d.
♈ ♎	2..10	2..33	3.. 8	4..18	W. N.	W. N.	W. N.	W. N.
♓ ♏	2.. 8	2..27	2..56	3..41	5.. 2	17..32	W. N.	W. N.
♒ ♐	2..18	2..43	3..26	11..38	11..14	10..32	8..38	c. n.
♑	2..26	2..57	4.. 4	10..24	9..30	7..46	c. n.	c. n.

Tables of the Solar System.

Table 1, Shewing the greatest, mean, & least Distances of the primary Planets from the Sun, with their Excentri=cities in Miles; and the like for the Moon from our Earth.

	Greatest Dist. Mill. Th. Miles	Mean Distance Miles.	Least Distance Miles.	Eccentricity Miles.
Mercury	37.752.480	31.445.100	24.857.280	6.455.700
Venus	58.960.710	58.590.000	58.094.010	427.770
Earth	82.402.920	81.000.000	79.597.080	1.370.520
Mars	134.771.850	123.418.890	111.941.190	11.421.000
Jupiter	444.458.910	421.289.100	400.890.060	20.290.500
Saturn	816.757.020	772.578.000	729.254.350	44.307.000
Moon from the Earth	258.131	240.675	223.734	17.046

Table 2, Shewing the Diameters of the Sun & Planets in Miles, and also the Surface, Magnitude & Quantity of Matter in each, the Surface & Magnitude of our Earth being 1, or Unity.

	Diameters.	Surfaces.	Magnitudes.	Quant. Matt.
Sun	763.460 Miles	9.241	888.300	200.000
Mercury	2.460	$\frac{1}{10}$	$\frac{1}{33}$	$\frac{1}{30}$
Venus	7.906	Nearly 1	Nearly 1	$\frac{4}{5}$
Earth	7.942	1	1	1
Mars	4.444	$\frac{1}{3}$	$\frac{1}{16}$	$\frac{1}{13}$
Jupiter	81.155	104	1.066	214
Saturn	67.870	73	624	76
Moon	2.175	$\frac{1}{13}$	$\frac{1}{50}$	$\frac{1}{46}$

Table 3, Shewing how many Miles the Planets move in their Orbits, per Day, Hour and Minute, at a Mean.

	Per Day.	Per Hour.	Per Minute.
Mercury	2.181.818	90.909	1.515
Venus	1.576.837	65.701	1.095
Earth	1.395.307	58.138	985
Mars	1.074.235	44.759	746
Jupiter	587.189	24.466	407
Saturn	433.301	18.054	301
Moon	52.833	2.201	36

Table 4,

Table 4, Shewing the Planets daily mean Motions, with the Number of Miles they are drawn from their Rectilinear Direction per Hour, their Densities, Light & Heat, compared with our Earth.

	Daily Motion at Rest.	Hourly Grav: at Rest.	Densities.	Light & Heat.
Sun			1/4	4.5.000
Mercury	4 - 5 - 32	129 Miles	1 1/10	7
Venus	1 - 36 - 8	36 1/2	4/5	2
Earth	0 - 59 - 8	25	1	1
Mars	0 - 31 - 57	8	7/10	4/10
Jupiter	0 - 4 - 59	71/100	1/4	1/27
Saturn	0 - 2 - 0	21/100	1/6	1/90
Moon	13 - 9 - 24	10	1/4	1

Table 5, Shewing the times in which the Planets move round the Sun, and also round their own Axis.

	Rotations round their own Axis. Days. Ho. M.	Revolutions round the Sun. at Rest. Days. Ho. M.
Sun	25 - 5 - 0	
Mercury	0 - 6 - 0	87 - 23 - 16
Venus	0 - 23 - 0	224 - 16 - 49
Earth	0 - 23 - 56	365 - 5 - 49
Mars	1 - 0 - 40	686 - 23 - 27
Jupiter	0 - 9 - 56	4332 - 12 - 20
Saturn	29 - 10 - 1	10759 - 6 - 36
Moon	27 - 7 - 45	27 - 7 - 45 round the Earth.

Table 6, Of the Inclination of the Planets Orbits, to the Plane of the Ecliptic, and the Inclination of their Axis to their own Orbits.

	Inc. to Ecliptic. ° '	Axes Inc. to their own Orbits.
Sun	87 - 30	At Rest.
Mercury	6 - 54	Not known.
Venus	3 - 24	Not known.
Earth	coincident	66 - 30
Mars	1 - 52	Perp. nearly.
Jupiter	1 - 20	Perp. nearly.
Saturn	2 - 30	31 - 0
Moon	5 - 18	Right Ang. nearly

Table 7

Table 7, Of the Sun and Planets greatest and least apparent Diameters, as viewed from the Earth.

	Diam. in Perigeon	Diam. in Apogeon
Sun	32 .. 47 .. 0	31 .. 40 .. 0
Mercury	0 .. 11 .. 48	0 .. 4 .. 4
Venus	1 .. 5 .. 58	0 .. 9 .. 34
Mars	0 .. 20 .. 50	0 .. 2 .. 46
Jupiter	0 .. 24 .. 12	0 .. 14 .. 36
Saturn	0 .. 19 .. 40	0 .. 14 .. 11
Moon	29 .. 24 .. 0	33 .. 40 .. 0

Table 8, Shewing the Places of the Planets Nodes & Aphelions.

	Nodes.	Aphelions.
Mercury	♉ 15 .. 1 .. 54	♐ 13 .. 7 .. 54
Venus	♊ 14 .. 25 .. 54	♏ 4 .. 19 .. 54
Earth	.... None	♑ 8 .. 1 .. 10
Mars	♌ 18 .. 29 .. 54	♍ 0 .. 31 .. 54
Jupiter	♋ 7 .. 19 .. 54	♎ 9 .. 9 .. 54
Saturn	♋ 21 .. 49 .. 54	♐ 27 .. 49 .. 54

Table 9, Shewing the mean Distances of Jupiter's Satellites from his Centre, in Diameters of his Body, and the times of their Revolutions round him.

Satellites.	Distances	Revolutions	Magnit.
	Semi-Diam.	Days. H. M. S.	
First	2 5/6	1 .. 18 .. 27 .. 34	2
Second	4 1/2	3 .. 13 .. 13 .. 42	3
Third	7 1/6	7 .. 3 .. 42 .. 36	1
Fourth	12 2/3	16 .. 16 .. 32 .. 9	4

Table 10, Shewing the Weights of equal Quantities of Matter, on the Surface of each Planet.

	Weights.		Weights.
Sun	25	Mars	1/3
Mercury	1/26	Jupiter	2
Venus	1/15	Saturn	1 1/3
Earth	1	Moon	1/3

Table 11,

Table II, Shewing the mean Distances of Saturn's Satellites from his Centre, in Diameters of his Ring; & the Times of their Revolutions.

	Miles
The Distance of Saturn's Ring from his Body	21.000
Breadth or Thickness of the Ring	21.000
Diameter of the Ring passing through Saturn	152.000
Inclination of the Ring to the Ecliptic	31°. 0'. 0"

Satellites.	Distances.	Revolutions. Days. H. ′. ″
First	$\frac{19}{20}$	1.. 21.. 18.. 26
Second	$1\frac{1}{5}$	2.. 17.. 41.. 10
Third	$1\frac{7}{10}$	4.. 12.. 25.. 10
Fourth	4	15.. 22.. 41.. 28
Fifth	$11\frac{13}{19}$	79.. 7.. 46.. 0

Table 12, Shewing in how long Time each of the Planets are conjoined with the Sun.

Mercury, in a Conjunction of the same kind, in 115 Days.
Venus, in a Conjunction of the same kind, in 584 Days.
Mars, in a Conjunction with the Sun, every 780 Days.
Jupiter, in Conjunction with the Sun, every 398 Days.
Saturn, in Conjunction with the Sun, every 378 Days.

Table 13, Shewing how many Degrees the Sun is usually under the Horizon, before the Planets & Stars appear.

Moon is often seen in the Day-time.	
Venus when horned about	5°.
Jupiter and Mercury	10°.
Saturn and Mars	11°.
Stars of the first Magnitude	12.
Second	13°.
Third	14°.
Fourth	15°.
Fifth	16°.
Sixth	17°.
Beginning of Twilight	18°.

Table 14,

Table 14, Shewing the Increase of Heat toward the Equinoctial Line, and it's Decrease toward the Poles, when the Sun is in the Equator; according to the Obliquity of the Solar Rays.

Lattitude	Quant. of Heat
0°	20.000
11	19.696
20	18.796
30	17.321
40	15.321
50	12.155
60	10.000
70	6.140
80	3.473
90	0.000

This Table will be alike useful for any Time when the Sun is not in the Equator, if due Allowance be made for his Declination.

Tables and Rules.

&c, &c.

Vol: Second.

By An Act of Parliament made in the Year 1751 for regulating the Commencement of the Year; and for correcting the Calendar; It is enacted, that the 1st Day of January 1752 be accounted the first Day of the Year in England, instead of the 25th of March as formerly: And Also, that the New or Gregorian Stile, which is Eleven Days before the Julian or Old Stile, take place in Great Britain, and all the Dominions belonging thereto, from and after the 2d of September 1752: So that the 3d Day of the said September is to be accounted and called the 14th, the 4th of the said Month to be the 15th, and so on. It is further enacted, for preserving the Calendar or method of computing the Days of the Year in the same regular course, as near as may be, no hundredth Year, except every fourth Hundredth Year, are to be accounted Bissextile or Leap Years; [which hundredth Years, that are Bissextile, are marked B in the Table on Page 9.] But that the other intermediate Leap Years, according to the Old or Julian Supputation, are to be accounted Bissextile or Leap Years according to the New reckoning, That is, Years consisting of 366 Days, whereas the others have only 365 Days. It is likewise enacted that the Immoveable Feasts be observed on the same Nominal Days of the Month as formerly: And that Easter, and the other Moveable Feasts depending thereon, be regulated according to the Tables and Rules annexed to the said Act of Parliament, a Copy of which Tables & Rules is contained in the following Collection from the beginning to the 16th Page inclusive.

Tables and Rules

for finding

Easter; Gold: Numbr;

Epact, Dom: Letter;

&c, &c, &c.

Vol: 2d

Carefully Transcribed

By

William Walker.

Near Old Meldrum.

1751.

Vol: 2d

Table to find Easter-Day from the present Time, till the Year 1899 inclusive according to the New Calendar.

Golden Numbers.	Days of the Month.	Sunday Letters.
14	March 21	C
3	22	D
	23	E
11	24	F
	25	G
19	26	A
8	27	B
	28	C
16	29	D
5	30	E
	31	F
13	April ... 1	G
2	2	A
	3	B
10	4	C
	5	D
18	6	E
7	7	F
	8	G
15	9	A
4	10	B
	11	C
12	12	D
1	13	E
	14	F
9	15	G
	16	A
17	17	B
6	18	C
	19	D
	20	E
	21	F
	22	G
	23	A
	24	B
	25	C

This Table contains so much of the Calendar, as is necessary for the determining of Easter; to find which, look for the Golden Number of the Year in the first Column of the Table, against which stands the Day of the Paschal Full Moon; then look in the third Column for the Sunday Letter, next after the Day of the Full Moon, and the Day of the Month standing against the Sunday Letter is Easter-day. If the Full Moon happens upon a Sunday, then (according to the Rule) the next Sunday after is Easter-day.

To find the Golden Number, or Prime, add one to the Year of our Lord, & then divide by 19; the Remainder, if any, is the Golden Number; but if nothing remaineth, then 19 is the Golden Number.

To find the Dominical Letter according to the New Calendar, untill the Year 1999 inclusive, add to the Year of our Lord its Fourth Part, omitting Fractions, & also the Number 1: Divide the sum by 7; and if there is no Remainder, then A is the Sunday Letter: But if any Number remaineth, then the Letter standing against that Number in the Small annexed Table, is the Sunday Letter.

0	A
1	B
2	C
3	D
4	E
5	F
6	G

For the next Century, that is, from the Year 1900 till the Year 1999 inclusive, add to the Current Year only its Fourth part, & then divide by 7, & proceed as in the last Rule.

Note, That in all Bissextile or Leap-years the Letter found, as above, will be the Sunday Letter from the intercalated Day exclusive, to the End of the Year.

Another Table to find Easter till the Year 1999 inclusive.

Sunday Letters.

Golden Numb.	A	B	C	D	E	F	G
1	April. 16	17	18	19	20	14	15
2	April ... 9	3	4	5	6	7	8
3	March. 26	27	28	29	23	24	25
4	April .. 16	17	11	12	13	14	15
5	April ... 2	3	4	5	6	March. 31	April ... 1
6	April .. 23	24	25	19	20	21	22
7	April ... 9	10	11	12	13	14	8
8	April ... 2	3	March. 28	29	30	31	April ... 1
9	April .. 16	17	18	19	20	21	22
10	April ... 9	10	11	5	6	7	8
11	March. 26	27	28	29	30	31	25
12	April .. 16	17	18	19	13	14	15
13	April ... 2	3	4	5	6	7	8
14	March. 26	27	28	22	23	24	25
15	April .. 16	10	11	12	13	14	15
16	April .. 2	3	4	5	March. 30	31	April . 1
17	April ... 23	24	18	19	20	21	22
18	April ... 9	10	11	12	13	7	8
19	April ... 2	March. 27	28	29	30	31	April . 1

To make use of the preceeding Table, find the Sunday Letter for the Year in the uppermost Line, & the Golden Number, or Prime, in the first Column, & in the same Line to it under the Sunday Letter you have the Day of ye Month on which Easter falleth that Year. But Note, That the Name of the Month is set on the left Hand, or just with the Figure, and followeth not, as in other Tables, by Descent, but Collateral.

A Table of the Moveable Feasts for

Year of our Lord.	The Golden Number.	The Epact.	Sunday Letters.	Sundays after Epiph.	Septuagesima Sunday.	Shrove Tuesday.	Easter-Day.	Rogation-Sunday.	Ascension-Day.	Whit-Sunday.	Sundays after Trin.	Advent Sunday.
1752	5											Dec: 3
1753	6	25	G	6	Feb: 18	Mar: 7	Apr: 22	May 27	May: 31	June. 10	23	2
1754	7	6	F	4	10	Feb. 27	14	19	23	2	24	1
1755	8	17	E	2	Jan: 26	12	Mar: 30	4	8	May. 18	26	Nov: 30
1756	9	28	D C	5	Feb: 15	Mar. 3	Apr: 18	23	27	June. 6	23	28
1757	10	9	B	4	6	Feb: 23	10	15	19	May 29	24	27
1758	11	20	A	2	Jan: 22	8	Mar: 26	Apr: 30	4	14	27	Dec: 3
1759	12	1	G	5	Feb: 11	28	Apr: 15	May 20	24	June. 3	24	2
1760	13	12	F E	3	3	20	6	11	15	May 25	25	Nov: 30
1761	14	23	D	1	Jan: 18	4	Mar: 22	Apr: 26	Apr: 30	10	27	29
1762	15	4	C	4	Feb: 7	24	Apr: 11	May 16	May. 20	30	24	28
1763	16	15	B	3	Jan: 30	16	3	8	12	22	25	27
1764	17	26	A G	6	Feb: 19	Mar: 7	22	27	31	June 10	23	Dec: 2
1765	18	7	F	3	3	Feb: 20	7	12	16	May 26	25	1
1766	19	18	E	2	Jan: 26	12	Mar: 30	4	8	18	26	Nov: 30
1767	1	0	D	5	Feb: 15	Mar. 4	Apr: 19	24	28	June. 7	23	29
1768	2	11	C B	3	Jan: 31	Feb: 17	3	8	12	May 22	25	27
1769	3	22	A	2	22	8	Mar: 26	Apr: 30	4	14	27	Dec: 3
1770	4	3	G	5	Feb: 11	28	Apr: 15	May 20	24	June. 3	24	2
1771	5	14	F	2	Jan: 27	13	Mar: 31	5	9	May. 19	26	1
1772	6	25	E D	5	Feb: 16	Mar: 4	Apr: 19	24	28	June. 7	23	Nov: 29
1773	7	6	C	4	7	Feb: 24	11	16	20	May. 30	24	28
1774	8	17	B	3	Jan: 30	16	3	8	12	22	25	27
1775	9	28	A	5	Feb. 12	Mar: 1	16	21	25	June. 4	24	Dec: 3
1776	10	9	G F	4	4	Feb: 21	7	12	16	May 26	25	1
1777	11	20	E	2	Jan: 26	12	Mar: 30	4	8	18	26	Nov: 30
1778	12	1	D	5	Feb: 15	Mar: 4	Apr: 19	24	28	June. 7	23	29

Fifty two Years, According to ye New Calendar

Year of our Lord	The Golden Number	The Epact.	Sunday Letter	Sundays after Epiph.	Septuagesima Sunday	The first day of Lent	Easter-Day.	Rogation-Sunday.	Ascension-Day.	Whitsunday.	Sundays after Trin.	Advent Sunday.
1779	13	12	C	3	Jan: 31	Feb: 17	Apr: 4	May. 9	May. 13	May 23	25	Nov: 28
1780	14	23	B A	2	23	9	Mar: 26	Apr: 30	4	14	27	Dec: 3
1781	15	4	G	5	Feb: 11	28	Apr: 15	May 20	24	June 3	24	2
1782	16	15	F	2	Jan: 27	13	Mar. 31	5	9	May. 19	26	1
1783	17	26	E	5	Feb: 16	Mar: 5	Apr: 26	25	29	June. 8	23	Nov: 30
1784	18	7	D C	4	8	Feb: 26	11	16	20	May. 30	24	28
1785	19	18	B	2	Jan: 23	9	Mar: 27	1	5	15	26	27
1786	1	0	A	5	Feb: 12	Mar: 1	Apr: 16	21	25	June. 4	24	Dec: 3
1787	2	11	G	4	4	Feb: 21	8	13	17	May 27	25	2
1788	3	22	F E	1	Jan: 20	6	Mar: 23	Apr: 27	1	11	27	Nov: 30
1789	4	3	D	4	Feb: 8	25	Apr: 12	May. 17	21	31	24	29
1790	5	14	C	3	Jan: 31	17	4	9	13	23	25	28
1791	6	25	B	6	Feb: 20	Mar. 9	24	29	June. 2	June 12	22	27
1792	7	6	A G	4	5	Feb: 22	8	13	May. 17	May 27	25	Dec: 2
1793	8	17	F	2	Jan: 27	13	Mar: 31	5	9	19	26	1
1794	9	28	E	5	Feb: 16	Mar: 5	Apr: 20	25	29	June. 8	23	Nov: 30
1795	10	9	D	3	1	Feb: 18	5	10	14	May. 24	25	29
1796	11	20	C B	2	Jan: 24	10	Mar: 27	1	5	15	26	27
1797	12	1	A	5	Feb: 12	Mar. 1	Apr: 16	21	25	June. 4	24	Dec: 3
1798	13	12	G	4	4	Feb: 21	8	13	17	May 27	25	2
1799	14	23	F	1	Jan: 20	6	Mar: 24	Apr: 28	2	12	27	1
1800	15	4	E	4	Feb: 9	26	Apr: 13	May. 18	22	June. 1	24	Nov: 30
1801	16	15	D	3	1	18	5	10	14	May 24	25	29
1802	17	26	C	5	C 14	Mar: 3	18	23	27	June. 6	23	28
1803	18	7	B	4	6	Feb: 23	10	15	19	May 29	24	27
1804	19	18	A G	3	Jan: 29	15	1	6	10	20	26	Dec: 2

A Table of the Moveable Feasts, According to these several Days that Easter can possibly fall upon.

Easter Day.	Sundays after Epiph.	Septuagesima Sund.	Ash Wednesday	Begation Sunday	Ascension Day.	Whitsunday.	Sundays after Trin.	Advent Sunday
Mar: 22	1	Jan: 18	Feb: 4	Apr: 26	Apr: 30	May. 10	27	Nov: 29
23	1	19	5	27	May. 1	11	27	30
24	1	20	6	28	2	12	27	Dec: 1
25	2	21	7	29	3	13	27	2
26	2	22	8	30	4	14	27	3
27	2	23	9	May. 1	5	15	26	Nov: 27
28	2	24	10	2	6	16	26	28
29	2	25	11	3	7	17	26	29
30	2	26	12	4	8	18	26	30
31	2	27	13	5	9	19	26	Dec: 1
Apr: 1	3	28	14	6	10	20	26	2
2	3	29	15	7	11	21	26	3
3	3	30	16	8	12	22	25	Nov: 27
4	3	31	17	9	13	23	25	28
5	3	Feb: 1	18	10	14	24	25	29
6	3	2	19	11	15	25	25	30
7	3	3	20	12	16	26	25	Dec: 1
8	4	4	21	13	17	27	25	2
9	4	5	22	14	18	28	25	3
10	4	6	23	15	19	29	24	Nov: 27
11	4	7	24	16	20	30	24	28
12	4	8	25	17	21	31	24	29
13	4	9	26	18	22	June. 1	24	30
14	4	10	27	19	23	2	24	Dec: 1
15	5	11	28	20	24	3	24	2
16	5	12	Mar: 1	21	25	4	24	3
17	5	13	2	22	26	5	23	Nov: 27
18	5	14	3	23	27	6	23	28
19	5	15	4	24	28	7	23	29
20	5	16	5	25	29	8	23	30
21	5	17	6	26	30	9	23	Dec: 1
22	6	18	7	27	31	10	23	2
23	6	19	8	28	June. 1	11	23	3
24	6	20	9	29	2	12	22	Nov: 27
25	6	21	10	30	3	13	22	28

Note. That in Bissextile or Leap-Year, the Number of Sundays after Epiphany will be the same, as if it had fallen in the next following Year, one Day later than really it is: And for the same reason, one Day must in every Leap-Year, be added to the Day of the Month given by the Table for Septuagesima Sunday: And the like must be done for the first Day of Lent (commonly called Ash-Wednesday) unless in the Case the Day given by the Table is the right Day.

Table to find Easter-Day, from the Year 1900, to the Year 2199 inclusive.

Golden Numbers	Days of the Month	Sunday Letters.
14	March 22	D
3	23	E
	24	F
11	25	G
	26	A
19	27	B
8	28	C
	29	D
16	30	E
5	31	F
	April 1	G
13	2	A
2	3	B
	4	C
10	5	D
	6	E
18	7	F
7	8	G
	9	A
15	10	B
4	11	C
	12	D
12	13	E
1	14	F
	15	G
9	16	A
17	17	B
6	18	C
	19	D
	20	E
	21	F
	22	G
	23	A
	24	B
	25	C

The Golden Numbers in the New Calendar will point out the Days of the Paschal Full Moons, till the Year of our Lord 1900; at which time, in order that the Ecclesiastical Full Moons may fall nearly on the same Days with the real Full Moons, the Golden Numbers must be removed to different Days of the Calendar, as is done in the annexed Table, which contains so much of the Calendar then to be used, as is necessary for finding the Paschal Full Moons, & the Feast of Easter, from the Year 1900, to the Year 2199 inclusive.

This Table is to be made use of, in all respects, as the first Table before inserted, for finding Easter till the Year 1999.

General Tables for finding the Dominical or Sunday Letter, and the Places of the Golden Numbers in the Calendar.

Table I.

6	5	4	3	2	1	0
B	C	D	E	F	G	A
				1600	1700	1800
1900 2000	2100	2200	2300 2400	2500	2600	2700 2800
2900	3000	3100 3200	3300	3400	3500 3600	3700
3800	3900 4000	4100	4200	4300 4400	4500	4600
4700 4800	4900	5000	5100 5200	5300	5400	5500 5600
5700	5800	5900 6000	6100	6200	6300 6400	6500
6600	6700 6800	6900	7000	7100 7200	7300	7400
7500 7600	7700	7800	7900 8000	8100	8200	8300 8400
8500	&c.					

To find the Dominical, or Sunday Letter for any given Year of our Lord add to the Year its fourth part, omitting Fractions, & also ye Number, which in Table I standeth at the Top of the Column, wherein the Number of Hundreds, contained in that given Year, is found: Divide the Sum by 7, and if there is no Remainder, then A is the Sunday Letter; but if any Number remaineth, then the Letter, which standeth under that Number at the Top of the Table, is the Sunday Letter.

Table II.

1	2 Years of our Lord	3		1	2 Years of our Lord	3
B.	1600	0		B	5200	15
	1700	1			5300	16
	1800	1			5400	17
	1900	2			5500	17
B	2000	2		B	5600	17
	2100	2			5700	18
	2200	3			5800	18
	2300	4			5900	19
B	2400	3		B	6000	19
	2500	4			6100	19
	2600	5			6200	20
	2700	5			6300	21
B	2800	5		B	6400	20
	2900	6			6500	21
	3000	6			6600	22
	3100	7			6700	23
B	3200	7		B	6800	22
	3300	7			6900	23
	3400	0			7000	24
	3500	9			7100	24
B	3600	8		B	7200	24
	3700	9			7300	25
	3800	10			7400	23
	3900	10			7500	26
B	4000	10		B	7600	26
	4100	11			7700	26
	4200	12			7800	27
	4300	12			7900	26
B	4400	12		B	8000	27
	4500	13			8500	28
	4600	13			8200	29
	4700	14			8300	29
B	4800	14		B	8400	29
	4900	14			8500	0
	5000	15				
	5100	16			&c.	

To find the Month & Days of the Month, to which the Golden Number ought to be prefixed in the Calendar, in any given Year of our Lord consisting of entire Hundreds Years, and in all the intermediate Years betwixt that & the next Hundredth Years following, look in the second Column of Table II for the given Year consisting of entire Hundreds, and Note the Number or Cypher which stands against it in the third Column; then, in Table III look for ye same Number under any given Golden Number, which when you have found guide your Eye side ways to the left hand, and in the first Column you will find the Month and Day, to wch that Golden Number ought to be prefixed in the Calender during that Period of one Hundreed Years.

The Letter B prefixed to certain Hundredth Years in Table II denotes those Years which are still to be accounted Bissextile, or Leap Years, in the New Calendar, whereas all the other Hundredth Years are to be accounted only Common Years.

Table III.

1	2	The Golden Numbers.																		
Paschal Full Moon	Sunday Letter.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
23 March..23	C	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26
22 March..22	D	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27
21 March...23	E	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28
20 March..24	F	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29
19 March...25	G	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0
18 March..26	A	13	24	5	16	27	8	19	0	11	22	3	14	25	6	16	28	9	20	1
17 March...27	B	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2
16 March...28	C	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3
15 March...29	D	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4
14 March...30	E	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5
13 March...31	F	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6
12 April....1	G	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7
11 April....2	A	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8
10 April....3	B	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9
9 April.....4	C	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10
8 April.....5	D	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11
7 April.....6	E	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12
6 April.....7	F	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13
5 April.....8	G	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14
4 April.....9	A	27	8	19	1	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15
3 April....10	B	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16
2 April....11	C	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17
1 April....12	D	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18
0 April....13	E	1	12	23	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19
29 April....14	F	2	13	24	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20
28 April....15	G	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21
27 April....16	A	4	15	26	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22
26 April....17	B	5	16	27	8	19	0	11	22	3	14	25	6	17	28	9	20	1	12	23
25 April....18	C	6	17	28	9	20	1	12	23	4	15	26	7	18	29	10	21	2	13	24
24 April....19	C	7	18	29	10	21	2	13	24	5	16	27	8	19	0	11	22	3	14	25

N. B. The marginal figures, on the Left hand, shew that the opposite figures on the right, beyond the Dom. Letter, are the Epacts, under their corresponding Golden Numbers, for the several Centuries in Table 2. that have the same marginal figures annexed to them in the 3d Column.

A Table for finding Easter according to both the Old and New Calendar.

Golden Number.	Gregorian Epact.	Dominical Letter.	Easter Day.
1	23		
	22	D	March 22
	21	E	23
13	20	F	24
2	19	G	25
	18	A	26
10	17	B	27
	16	C	28
18	15	D	29
7	14	E	30
	13	F	31
15	12	G	April 1
4	11	A	2
	10	B	3
12	9	C	4
	8	D	5
	7	E	6
9	6	F	7
	5	G	8
17	4	A	9
6	3	B	10
	2	C	11
14	1	D	12
3	0	E	13
	29	F	14
11	28	G	15
	27	A	16
19	25.26	B	17
8	25.24	C	18
		D	19
		E	20
		F	21
		G	22
		A	23
		B	24
		C	25

To find Easter, according to the Old Calendar, Seek the Golden Number in the first Column, and the Dominical Letter downward therefrom in the third Column, and over against the said Letter you have the Day on which Easter falls.

To find Easter, according to the New Calendar, Seek the Epact in the second Column, and the Dominical Letter downward therefrom in the third Column, and over against the said Letter you have the Day on which Easter falls according to the New account.

Note, That the Moveable Feasts depending on Easter, according to this last computation, will be found, Page 6, in the Table of Moveable Feasts according to the several Days that Easter can possibly fall upon.

Note, That when the Epact 25 falls under any of the first eleven Golden Numbers, the 25 set down with 24 in this Table shews the Paschal full Moon; but when it falls under any of the other Golden Numbers, the 25 set down with 26 does it.

A Table to find the Movable Feasts till the Year 1899 inclusive by the Dominical Letter and Golden Number.

Dom: Letter	Golden Numbers	Sun after Ep:	Septuag: Sunday	1st Day of Lent	Easter Day	Rogation Sunday	Ascens: on Day	Whit-Sunday	Sun: after Trin	Advent Sunday
A	3.11.14	2	Jan: 22	Feb: 8	Mar: 26	Apr: 30	May. 4	May. 14	27	Dec. 3
	5. 8.13.16.19	3	29	15	April. 2	May. 7	11	21	26	3
	2. 7.10.18	4	Feb: 5	22	April. 9	14	18	28	25	3
	1. 4. 9.12.15	5	12	Mar: 1	April 16	21	25	June. 4	24	3
	6.17.	6	19	8	April 23	28	June. 1	11	23	3
B	3.11.14.19	2	Jan: 23	Feb: 9	Mar: 27	May. 1	May. 5	May 15	26	Nov: 27
	2. 5. 8.13.16	3	30	16	April. 3	8	12	22	25	27
	7.10.13.18	4	Feb: 6	23	April 10	15	19	29	24	27
	1. 4. 9.12	5	13	Mar: 2	April 17	22	26	June. 5	23	27
	6.17.	6	20	9	April 24	29	June. 2	12	22	27
C	3. 8.11.14.19	2	Jan: 24	Feb: 10	Mar: 28	May. 2	May. 6	May 16	26	Nov: 28
	2. 5.13.16	3	31	17	April. 4	9	13	23	25	28
	4. 7.10.15.18	4	Feb: 7	24	April 11	16	20	30	24	28
	1. 9.12.17	5	14	Mar: 3	April 18	23	27	June. 6	23	28
	6	6	21	10	April 25	30	June. 3	13	22	28
D	14	1	Jan: 18	Feb: 4	Mar: 22	Apr: 26	Apr: 30	May 10	27	Nov: 29
	3. 8.11.19	2	25	11	Mar: 29	May. 3	May. 7	17	26	29
	2. 5.10.13.16	3	Feb: 1	18	April. 5	10	14	24	25	29
	4. 7.15.18	4	8	25	April 12	17	21	31	24	29
	1. 6. 9.12.17	5	15	Mar 4	April 19	24	28	June. 7	23	29
E	3.14	1	Jan: 19	Feb: 5	Mar: 23	Apr: 27	May. 1	May. 11	27	Nov: 30
	8.11.16.19	2	26	12	Mar: 30	May. 4	8	18	26	30
	2. 5.10.13	3	Feb: 2	19	April. 6	11	15	25	25	30
	4. 7.15.18.12	4	9	26	April. 13	18	22	June. 1	24	30
	1. 6. 9. 17	5	16	Mar: 5	April. 20	25	29	8	23	30
F	3.14	1	Jan: 20	Feb: 6	March 24	Apr: 28	May. 2	May. 12	27	Dec: 1
	5. 8.11.16.19	2	27	13	Mar: 31	May. 5	9	19	26	1
	2.10.13.18	3	Feb: 3	20	April. 7	12	16	26	25	1
	1. 4. 7.12.15	4	10	27	April. 14	19	23	June. 2	24	1
	6. 9.17.	5	17	Mar: 6	April. 21	26	30	9	23	1
G	3.11.14.	2	Jan: 21	Feb: 7	March 25	Apr: 29	May. 3	May. 13	27	Dec: 2
	5. 8.16.19	3	28	14	April. 1	May. 6	10	20	26	2
	2. 7.10.13.18	4	Feb: 4	21	April. 8	13	17	27	25	2
	1. 4.12.15.	5	11	28	April. 15	20	24	June. 3	24	2
	6. 9.17	6	18	Mar. 7	April. 22	27	31	10	23	2

A Table for the ready finding of the Golden Number for 1900 Years, and may be continued for ever.

Gold: Num:	Years of our Lord.						100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
	0	0	0	0	0	0	6	11	16	2	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1
2	1	20	39	58	77	96	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1	6	11	16	2
3	2	21	40	59	78	97	8	13	18	4	9	14	19	5	10	15	1	6	11	16	2	7	12	17	3
4	3	22	41	60	79	98	9	14	19	5	10	15	1	6	11	16	2	7	12	17	3	8	13	18	4
5	4	23	42	61	80	99	10	15	1	6	11	16	2	7	12	17	3	8	13	18	4	9	14	19	5
6	5	24	43	62	81		11	16	2	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1	6
7	6	25	44	63	82		12	17	3	8	13	18	4	9	14	19	5	10	15	1	6	11	16	2	7
8	7	26	45	64	83		13	18	4	9	14	19	5	10	15	1	6	11	16	2	7	12	17	3	8
9	8	27	46	65	84		14	19	5	10	15	1	6	11	16	2	7	12	17	3	8	13	18	4	9
10	9	28	47	66	85		15	1	6	11	16	2	7	12	17	3	8	13	18	4	9	14	19	5	10
11	10	29	48	67	86		16	2	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1	6	11
12	11	30	49	68	87		17	3	8	13	18	4	9	14	19	5	10	15	1	6	11	16	2	7	12
13	12	31	50	69	88		18	4	9	14	19	5	10	15	1	6	11	16	2	7	12	17	3	8	13
14	13	32	51	70	89		19	5	10	15	1	6	11	16	2	7	12	17	3	8	13	18	4	9	14
15	14	33	52	71	90		1	6	11	16	2	7	12	17	3	8	13	18	4	9	14	19	5	10	15
16	15	34	53	72	91		2	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1	6	11	16
17	16	35	54	73	92		3	8	13	18	4	9	14	19	5	10	15	1	6	11	16	2	7	12	17
18	17	36	55	74	93		4	9	14	19	5	10	15	1	6	11	16	2	7	12	17	3	8	13	18
19	18	37	56	75	94		5	10	15	1	6	11	16	2	7	12	17	3	8	13	18	4	9	14	19
1	19	38	57	76	95		6	11	16	2	7	12	17	3	8	13	18	4	9	14	19	5	10	15	1

In this Table, the first Column contains the Golden Numbers answering to the Years of our Lord under 100. On the Top are hundredth Years, and immediately below them are their respective Golden Numbers And to find the Number for the intermidiate Years, find the Year under ye proper Titles in a direct Line y^r^ from under ye Proper 100th is ye Gold: Numb: sought.

The Golden Numbers with their Coresponding Epacts.

N.S. Greg: Epact.	0	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29
Golden Numbs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
O.S. Julian Epact.	11	22	3	14	25	6	17	28	9	20	1	12	23	4	15	26	7	18	29	

A Table shewing the Dominical Letter from the Year of our Lord 1700 to the Year 3299, and may be continued for ever.

Years of our Lord.	1700	1800	1900	2000
	2100	2200	2300	2400
	2500	2600	2700	2800
	2900	3000	3100	3200
0 0 0 0	C	E	G	B A
1 29 57 85	B	D	F	G
2 30 58 86	A	C	E	F
3 31 59 87	G	B	D	E
4 32 60 88	F E	A G	C B	D C
5 33 61 89	D	F	A	B
6 34 62 90	C	E	G	A
7 35 63 91	B	D	F	G
8 36 64 92	A G	C B	E D	F E
9 37 65 93	F	A	C	D
10 38 66 94	E	G	B	C
11 39 67 95	D	F	A	B
12 40 68 96	C B	E D	G F	A G
13 41 69 97	A	C	E	F
14 42 70 98	G	B	D	E
15 43 71 99	F	A	C	D
16 44 72	E D	G F	B A	C B
17 45 73	C	E	G	A
18 46 74	B	D	F	G
19 47 75	A	C	E	F
20 48 76	G F	B A	D C	E D
21 49 77	E	G	B	C
22 50 78	D	F	A	B
23 51 79	C	E	G	A
24 52 80	B A	D C	F E	G F
25 53 81	G	B	D	E
26 54 82	F	A	C	D
27 55 83	E	G	B	C
28 56 84	D C	F E	A G	B A

In this Table the Hun=dredth Years are placed on the Top, and have their re=spective Dominical Letters immediately below them in the same Line with the Cyphers. And to find for the interme=diate Years, seek the Year in the Columns on the left hand, and in a direct Line therefrom to the right and under the proper Hun=dredth is the Letter sought.

Note, In every four hun=dred Years, according to the New Stile, there is a Re=volution of the Dominical Letters in the same order, as represented in this Table.

Another Table shewing the Dominical Letter for four Centu-ries from 1752 to the Year 2152, and may be continued for ever.

E 1 D 2 C 3	G 1 F 2 E 3	B 1 A 2 G 3	D 1 C 2 B 3	F 1 E 2 D 3	A 1 G 2 F 3	C 1 B 2 A 3
B A	D C	F E	A G	C B	E D	G F
1752	56	60	64	68	72	76
80	84	88	92	96		
		1800 E	4	8	12	16
20	24	28	32	36	40	44
48	52	56	60	64	68	72
76	80	84	88	92	96	
			1900 G	4	8	12
16	20	24	28	32	36	40
44	48	52	56	60	64	68
72	76	80	84	88	92	96
2000	4	8	12	16	20	24
28	32	36	40	44	48	52
56	60	64	68	72	76	80
84	88	92	96			
	2100 C	4	8	12	16	20
24	28	32	36	40	44	48
52	&c.					

In this Table are marked the Bisextile, or Leap Years, with their proper double Letters above each Column. The Letters for the Years after Bisextile are on the Top of the Table marked 1, 2, 3, and refer always to the preceeding Column of Bisextiles. The hundredth Years that are not Bisextile are marked in the Body of the Table with their proper Letters annexed.

A Table shewing the Dominical Letter, according to the Julian or Old stile, from the Year of our Lord 1700 to the Year 3000, and may be continued for ever.

Years of our Lord.	1700	1800	1900	2000	2100	2200	2300
	2400	2500	2600	2700	2800	2900	3000
0 28 56 84	G F	A G	B A	C B	D C	E D	F E
1 29 57 85	E	F	G	A	B	C	D
2 30 58 86	D	E	F	G	A	B	C
3 31 59 87	C	D	E	F	G	A	B
4 32 60 88	B A	C B	D C	E D	F E	G F	A G
5 33 61 89	G	A	B	C	D	E	F
6 34 62 90	F	G	A	B	C	D	E
7 35 63 91	E	F	G	A	B	C	D
8 36 64 92	D C	E D	F E	G F	A G	B A	C B
9 37 65 93	B	C	D	E	F	G	A
10 38 66 94	A	B	C	D	E	F	G
11 39 67 95	G	A	B	C	D	E	F
12 40 68 96	F E	G F	A G	B A	C B	D C	E D
13 41 69 97	D	E	F	G	A	B	C
14 42 70 98	C	D	E	F	G	A	B
15 43 71 99	B	C	D	E	F	G	A
16 44 72	A G	B A	C B	D C	E D	F E	G F
17 45 73	F	G	A	B	C	D	E
18 46 74	E	F	G	A	B	C	D
19 47 75	D	E	F	G	A	B	C
20 48 76	C B	D C	E D	F E	G F	A G	B A
21 49 77	A	B	C	D	E	F	G
22 50 78	G	A	B	C	D	E	F
23 51 79	F	G	A	B	C	D	E
24 52 80	E D	F E	G F	A G	B A	C B	D C
25 53 81	C	D	E	F	G	A	B
26 54 82	B	C	D	E	F	G	A
27 55 83	A	B	C	D	E	F	G

The Cycle of the Sun for finding the Dominical Letter according to the Julian or Old Stile

Cycle of the Sun	Dominical Letter
1	G F
2	E
3	D
4	C
5	B A
6	G
7	F
8	E
9	D C
10	B
11	A
12	G
13	F E
14	D
15	C
16	B
17	A G
18	F
19	E
20	D
21	C B
22	A
23	G
24	F
25	E D
26	C
27	B
28	A

The Cycle of the Sun, or more properly of Sunday Letters, is a Revolutional Number of 28 Years, in which Time there is a perfect change of all the Sunday Letters marked in the Calendar, according to the Julian Computation or Old Stile.

To find the Cycle, for any Year given, add 9 to the Year, and divide the Sum by 28, the Remainder is the Cycle sought, and if nothing remain the Cycle is 28. Having thus found the Cycle, this Table shews the proper Dominical Letter.

To find the Julian Dominical Letter without the help of the Cycle, to the Year given add its fourth part and 4, omitting Fractions, divide the Sum by 7, and the Remainder subtract from 7, the difference will be Number of the Letter sought reckoning them in order from A.

Note, That in all Bissextile, or Leap Years, the Letter found is the Sunday Letter from the intercalated Day inclusive to the end of the Year.

A	D	D	G	B	E
January	February	March	April	May	June
At	Dover	Dwells	George	Brown	Esquire,
Good	Christopher	Finch,	And	David	Fryer.
July	August	September	October	November	December.
G	C	F	A	D	F

In the above Distich the first Letter of each Word are the Letters affixed to the first Day of each Month in the Calendar, for the sake of Me=mory, whereby, knowing the Dominical Letter, it will be easy to find what Day of the Week any Month begins upon, and consequently, what Day of the Week any other Day of any Month is.

A Table shewing by the help of the Dominical Letter what Day of the Week any Month of the Year begins for ever.

Months.	A	B	C	D	E	F	G
Jan: 31	Sunday	Saturday	Friday.	Thursday.	Wedensday	Tuesday.	Monday.
Feb: 28	Wedensday	Tuesday.	Monday.	Sunday.	Saturday	Friday.	Thursday.
March 31	Wedensday	Tuesday.	Monday.	Sunday.	Saturday.	Friday.	Thursday.
April 30	Saturday.	Friday.	Thursday.	Wedensday	Tuesday.	Monday.	Sunday.
May 31	Monday.	Sunday.	Saturday.	Friday.	Thursday	Wedensday	Tuesday.
June 31	Thursday	Wedensday	Tuesday.	Monday.	Sunday.	Saturday.	Friday.
July 31	Saturday.	Friday.	Thursday	Wedensday.	Tuesday.	Monday.	Sunday.
August 31	Tuesday.	Monday.	Sunday.	Saturday.	Friday.	Thursday	Wedensday
Sept. 30	Friday.	Thursday	Wedensday.	Tuesday.	Monday	Sunday.	Saturday.
Oct. 31	Sunday.	Saturday.	Friday.	Thursday.	Wedensday.	Tuesday.	Monday.
Nov. 30	Wedensday.	Tuesday.	Monday.	Sunday.	Saturday.	Friday.	Thursday.
Dec. 31	Friday.	Thursday.	Wedensday.	Tuesday.	Monday.	Sunday.	Saturday.

A Table on the left hand shewing the Dominical Letter for 95 Years, and may be continued; Another on the right shewing the Day of the Month for ever by help of the Dominical Letter.

G	F	E	D	C	B	A
1753	54	55		56	57	58
59		60	61	62	63	
64	65	66	67		68	69
70	71		72	73	74	75
	76	77	78	79		80
81	82	83		84	85	86
87		88	89	90	91	
92	93	94	95		96	97
98	99	1800	1	2	3	
4	5	6	7		8	9
10	11		12	13	14	15

Months

	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				
January. October	A	B	C	D	E	F	G
May.	B	C	D	E	F	G	A
August.	C	D	E	F	G	A	B
Novr. Feb: March.	D	E	F	G	A	B	C
June.	E	F	G	A	B	C	D
September. Dec^r.	F	G	A	B	C	D	E
April. July.	G	A	B	C	D	E	F

In the first Table the Letters on the Top are the Sunday Letters for all the Years in the same Column before them; and for Leap Years the Letter above the blanck is the first, and that above the Figure is ye second Letter for the Year. In the 2^d Table, look for the Dominical Letter over against every Month, & the Figures in the same Column above it are all the Sundays for the said Month.

G	F	E	D	C	B	A
Sun:	Mun:	Tues:	Wed:	Thur:	Frid:	Satur:
Apr:	Sep:	June	Feb: Mar: Nov:	Aug.	May	Jan: Oct:
July.	D^o:					
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

In this Table, if any Year, Month, or Day be given; to find the Day of the Week, first find the Sunday Letter for ye Year given, & whatever Day of the Week is under it, the Figures below are the same Days of the Week to the several Months marked above them, G, C, if the Dom: Letter be G, under which, in this Table, is Sunday, then all the Figures under each Month are Sundays; if the Letter be F the Figures are Mundays, &c.

Tabula Nonarum, Iduum et Kalendarum.

Dies Mensis	Ap: Jun: Sep: Nov:	Jan: Aug: December.	Mar: Mai: Jul: Oct:	Februarius.
1	Kalendæ	Kalendæ	Kalendæ	Kalendæ
2	4	4	6	4
3	3	3	5	3
4	Prid: Non:	Prid: Non:	4	Prid: Non:
5	Nonæ	Nonæ	3	Nonæ
6	8	8	Prid: Non:	8
7	7	7	Nonæ.	7
8	6	6	8	6
9	5	5	7	5
10	4	4	6	4
11	3	3	5	3
12	Prid: Idus	Prid: Id.	4	Prid: Id:
13	Idus.	Idus.	3	Idus.
14	18	19	Prid Idus.	16
15	17	18	Idus.	15
16	16	17	17	14
17	15	16	16	13
18	14	15	15	12
19	13	14	14	11
20	12	13	13	10
21	11	12	12	9
22	10	11	11	8
23	9	10	10	7
24	8	9	9	6
25	7	8	8	5
26	6	7	7	4
27	5	6	6	3
28	4	5	5	Prid: Kal:
29	3	4	4	
30	Prid Kal:	3	3	
31		Prid: Kal:	Prid: Kal:	

Aprilis, Junius, Septembris, Novembrisque, tricenos,
Unum plus reliqui, Februarius tenet Octo viginti:
Sed ut Bissextus fuerit, superadditur unus.
Principium Mensis cujusque vocato Kalendæ.
Mensibus, sex Nonas, Octobris, Julius, et Maius;
Quatuor at reliqui: Sonet Idus quilibet Octo.
Postquos, quot restant dies, numerato Kalendas;
Atque proximum Mensis sucem superadde sequentis.

A Table, shewing the Numbers of Days between any two Periods of Time not exceeding 365 Days, or a Year.

	To Jan:	To Feb:	To Mar:	To Apr:	To May	To June	To July	To Aug:	To Sep:	To Oct:	To Nov:	To Dec:	To Jan:
From Jan:	31	59	90	120	151	181	212	243	273	304	334	365	
From Feb:	28	59	89	120	150	181	212	242	273	303	334	365	
From March	31	61	92	122	153	184	214	245	275	306	337	365	
From April	30	61	91	122	153	183	214	244	275	306	334	365	
From May	31	61	92	123	153	184	214	245	276	304	335	365	
From June	30	61	92	122	153	183	214	245	273	304	334	365	
From July	31	62	92	123	153	184	215	243	274	304	335	365	
From Aug:	31	61	92	122	153	184	212	243	273	304	334	365	
From Sep:	30	61	91	122	153	181	212	242	273	303	334	365	
From Oct:	31	61	92	123	151	182	212	243	273	304	335	365	
From Nov:	30	61	92	120	151	181	212	242	273	304	334	365	
From Dec:	31	62	90	121	151	182	212	243	274	304	335	365	

Explanation of the preceeding Table.

When the Day computed from, and that computed to, are both the same Day of the Month, the Table gives the Answer by Inspection. When the Day computed to, is nearer the end of the Month, than that computed from, the difference is to be added to the Number found in the Table: When the reverse, the difference is to be subtracted. When the 29th of February, the Day intercalated every Leap Year, is in the time computed, 1 is to be added on that Account.

Ex: 1. If a Bill due the 20th of January 1751, is not paid till the 20th of December the same Year, how many Day's Interest is due upon it? — In a Line with the Words From Jan: and right under To Dec: you find 334, the Number sought, i.e. the Number of Days which Interest is due.

Ex: 2. What Number of Days is there from May 15th 1751, to Feb: 26th 1752? To 276, the Number found by the Table, add 11, the Difference between 15 and 26; and the amount, 287, is the Number sought.

Ex: 3. What Number of Days is there from Oct: 23d 1751, to Sep 14th 1752? From 335, the Number found by the Table, subtract 9, the difference between 23 and 14; to the Remainder, 326, add 1, for the 29th of February, 1752 being a Leap Year; and the amount, 327, is the Number sought. — But in Britain 11 Days of this Period are to be subtracted, because 11 Days, those which would have fallen between the 2d and 14th of September 1752, are to be cut off, in order then to introduce the New Style, so that the just Answer for People in Britain would be, 316.

Rules for calculating upon what Day of the Week any Day of the Vulgar Christian Æra falls.

For the Old Style.

To the Year add its fourth part*, the Number 5, and the Day of ye Year; and divide the amount by 7. The Remainder when there is any, & the Divisor 7 when there is no Remainder, is the Number of the Day of the Week sought.

For the New Style.

To the Year add its fourth part*, its four hundredth part*, & the Day of the Year; from the Amount subtract the hundredth part of ye Year*; and divide the residue by 7. The Remainder when there is any, & 7 when there is no Remainder is the Number sought.

* Leaving away any Fraction, & in Leap years where there is no Fraction, Subtract one instance in the Rule, from the Old Style, three in that for the New, as directed by the Rule.

Ex: 1. Upon what Day of y^e Week falls the 6th July 1751? O: S.

1751 the Year.
437 $\frac{1751}{4}$ less $\frac{3}{4}$.
5 invariable Number.
187 Day of the Year.
2380 Amount. Which divided by 7.
Rem: 0, that is, Saturday

Ex: 2. Upon what Day of y^e Week falls the 2^d of September 1752? O: S

1752 the Year
437 $\frac{1752}{4}$ less $\frac{4}{4}$ or 1.
5 invariable Number.
246 Day of the Year.
2440 Amount. Which divided by 7.
Rem: 4 that is, the 4th Day of y^e Week, Wednesday.

Ex: 1. Upon what Day of y^e Week falls the 25th of March 1753? A: S.

1753 the Year.
430 $\frac{1753}{4}$ less $\frac{1}{4}$.
4 $\frac{1753}{400}$ less $\frac{153}{400}$.
84 Day of the Year.
2279 Amount: from which subtract.
17 $\frac{1753}{100}$ less $\frac{53}{100}$.
2262 residue. Which divided by 7.
Rem: 1 that is, Sunday.

Ex: 2. Upon What Day of y^e Week falls the 1st of January 2000? A: S.

2000 the Year.
499 $\frac{2000}{4}$ less $\frac{4}{4}$, or 1.
4 $\frac{2000}{400}$ less $\frac{400}{400}$, or 1.
1 Day of the Year
2504 Amount: from which subtract.
19 $\frac{2000}{100}$ less $\frac{100}{100}$, or 1.
2485 residue. Which divided by 7.
Rem: 0 that is, Saturday.

An Explanation of the foregoing Rules for calculating on what Day of the Week any Day falls.

These Rules are in effect an easy method of dividing the Number of Days from the commencement of the Æra, by 7, the Number of Days in a Week.—If on such division there be no Remainder, the last Day of the Period calculated, must be the same with the 7th Day of the Æra which would be Saturday, our 7th Day of the Week, if the Æra had begun on Sunday: and if there be 1 of a Remainder, the last Day calculated, must be the same with the 1st Day of the Æra; and so on. But by calculating backwards according to the Old Style, the Æra will be found to have begun on Sunday: consequently, 1 of Remainder would correspond with Saturday, our 7th Day: 2 with Sunday our 1st; 3 with our 2d; & so on. It would however be more natural, that the Remainder, and the Number of the Day of the Week, were the same; and this would be effected by adding an adjusting number, 6.

The Numbers, then, of which the Dividend is composed, may be thus explained.—The Days in a common Year divided by 7, leave 1 of Remainder; therefore the Number of Years past of the Æra, is precisely the Number of these Remainders. But the Number of the current Year is taken, as thought to occur more readily: and the Unit of excess is taken from the adjusting Number, by reducing it from 6 to 5. The fourth of the Years answers to the Day intercalated every fourth or Leap-Year. Here the Fractions are thrown away, because 1 Day is added only every fourth Year; and an Integer is thrown away when there is no Fraction, i.e. upon Leap-Year because then the 29th of February, the Day intercalated, falls to be included in the Days of the Year. Thus then the days thrown out of preceding Years are neat Weeks, and the Days to be calculated of the current Year are taken intire; so that the Remainder after the Operation directed by the Rule, must be the same as if the Number of the Days from the commencement of the Æra were divided by 7.

Of the hundredth Years, three are always common, & only every fourth a Leap Year, by the New Style; so that by it there are three days less in every 400 Years than by the Old. This Accounts for the Addition of $\frac{1}{400}$ & the subtraction of $\frac{1}{100}$ (i.e. $\frac{4}{400}$) of the Year; which two Operations are the same in effect with subtracting $\frac{3}{400}$. No adjusting Number is necessary in the Rule for the New Style; because calculating by it, the Æra would have begun on Monday, two days later than it really did begin; and these two Days added to 5, the adjusting Number in the Rule for the Old Style, make a compleat Week.

A Table, shewing on what Day of the Week any Day of any Month in any Time past did fall, or in any time to come will fall, from the beginning of the Vulgar Christian Æra to the Year 1899 according to the Old Style, and from the Year 1600 to the Year 2799 according to the New Style; and which may be continued for ever.

Years

00		1	2	3	4	
5	6	7	8		9	10
11	12		13	14	15	16
	17	18	19	20		21
22	23	24		25	26	27
28		29	30	31	32	
33	34	35	36		37	38
39	40		41	42	43	44
	45	46	47	48		49
50	51	52		53	54	55
56		57	58	59	60	
61	62	63	64		65	66
67	68		69	70	71	72
	73	74	75	76		77
78	79	80		81	82	83
84		85	86	87	88	
89	90	91	92		93	94
95	96		97	98	99	

Centuries.

New Style Comm: in Britain Sep: 14th 1752.			Old Style ends in Britain Sep: 2. 1752		
2700	2300	1900	1800	1100	400
Monday			1700	1000	300
2600	2200	1800	1600	900	200
Wednesday			1500	800	100
2500	2100	1700	1400	700	0
Friday.			1300	600	
2400	2000	1600	1200	500	

Su:	Mo:	Tu:	We:	Th:	Fr:	Sa:
M.	Tu.	We.	Th.	Fr.	Sa.	Su.
Tu.	We.	Th.	Fr.	Sa.	Su.	M.
We.	Th:	Fr.	Sa.	Su.	M.	Tu.
Th:	Fr.	Sa.	Su.	M.	Tu.	We.
Fr.	Sa.	Su:	M.	Tu.	We.	Th.
Sa.	Su:	M.	Tu.	We.	Th.	Fr.

Months.

Common Years.			Leap Years.		
Jan:	Oct.		Jan.	Apr	July.
May.			Oct		
Aug.			May		
Feb.	Mar:	Nov	Feb:	Aug.	
June			Mar:	Nov:	
Sept.	Dec:		June		
Apr:	July.		Sep.	Dec.	

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Days.

Explanation.

Explanation of the foregoing Table.

The Table is divided into five parts. The left hand division contains the Centuries, or neat hundreds of Years; the upper Division, the Years, all under a hundred; the right hand Division, the Months; the lower Division, the Days of the Month; and the Centre, the Days of the Week.

Proper titles distinguish the Old and the New Styles in the left hand Division, and the Common and the Leap Years in the right hand division. — All the Neat Hundreds are Leap Years according to the Old Style; but according to the New, three of them are common Years, and only every fourth a Leap Year. In the left hand Division, under New Style, the Leap Years are always in the lowest Line, the common always in the three other Lines. —— In the upper Division, the place next after every Leap-year is necessarily blank, which to those who need such a help will point them out. This holds whatever Century the Year be of, and whatever Style we compute by. —— In the left hand division, in the place next below that of 100, there is a Cypher, to denote, that this place is a direction when the Year is below a hundred, i.e. when there is nothing in the place of hundreds: and in the upper division, in the first place, (i.e. the place that would fall to be filled up next before that 1, as there must necessarily be a blank next before the first of every three common Years), there are two Cyphers, to denote, that this place is a Direction when the Year is neat hundreds, i.e. when the places of tens and Units are Cyphers.

The Day of the Week on which the neat hundred Years that are common (i.e. all the years under New Style in the left hand division, except those in the foot Line) begin, is below the Years respectively. How to find the Day of the Week on which any other Day falls, is shewn by the following Examples.

1. On what Day of the Week will the 2d September 1752 O. S. fall? —— First, look in the left hand division, under Old Style, for 1700, the neat hundreds, and in the upper division for 52, the number above neat hundreds; and right under 52, in a Line with 1700, you find, in the Centre, Wednesday, the Day on which the Year began, i.e. the first Day of January. Then look in the Top Line of the Center for Wednesday, and in the right hand Division, under Leap Years, for Sept, and in a Line with this Sep, right under Wednesday in the Center top line, you find Tuesday the Day on w the Month begins. Lastly, look in the left hand Column of the Center for Tuesday, and in the lower Division for 2, the Day of y Month; and right above 2, in a Line with Tuesday in the Center left hand Column, you find Wednesday, the Day sought.

2. On

2. On what Day of the Week falls the 14th of Sep: 1752, N. S. fall? — Find a Line with 1700, New Style, and right under 52, you find Saturday, & right under Saturday in the Center Top-Line, and in a Line with Sept. 14. you find Friday; and in a Line wth Friday in the Center left hand Column, and right above 14, you find Thursday, the Day sought.

3. On what Day did the 10th of August 1700, O. S fall? — In a Line with 1700, Old Style, and right under 00, i.e. in the left hand Column of the Center, you find Sunday; right under Monday in the Center top-line, and in a line wth August, Sept. &c. you find Saturday; and in a Line with Thursday in the Center left hand Column, and right above 10, you find Saturday, the Day sought.

4. On what Day did the 21st of August 1700, N. S. fall? — Below 1700, New Style, you find Friday, the day on which the Year began; right under Friday in the Center top-line, and in a Line with August Common 1 you find Sunday; and in a Line with Sunday in the Center left hand Column, and right above 21, you find Saturday, the Day sought. — The Day sought by this and the former Example, is the same, computed by the different Styles.

5. On what day did 1st of January in the Year 1, i.e. the 1st Day of the Vulgar Christian Æra, fall? — In a Line with 0--, and right under 1, you find Saturday, the Day sought. — When the Month is in a Line with the Center top Line, the Day on which it begins is the same with that on which the Year begins; and when the Day sought is right under the Center left hand Column, it is the same wth y^e on wch ye Month begins.

The Table may be made to answer for any future Period, by adding Centuries to the left hand Division, in the order there observed, for either the Old or New Style, whichever we are to compute by; and for any Period before the 1500 to the beginning of the Æra, computing after the manner of the New Style.

Here it may be observed, that Pope Gregory XIII. upon the Day after the 4th of Octr 1582, when he introduced the New Style, threw out 10 Days; which, by carrying backwards the Computation he then established, brings the Coincidence of both Styles to be from March 1. 200 To February 28. 300, both inclusive; though they were intended to agree at the time of the Council of Nice, in the Year 325, when by his Computation there was one Day thrown out: but that to have made the 2 Styles agree from the beginning of the Æra, he should have thrown out 12 Days instead of 10 in 1582, & we now 13 Days instead of 11; as may be illustrated by ye following

Ex: On what Day the 1st of Jan: in the Year 1 fall, according to the New Style? By the order for the New Style in the left hand Division, the first Century, or 100, falls to be placed in the 3^d Line from the Foot; Friday in the Line next below a 100, and 0-- in the Foot Line, in the same Way as the place next below 100 in the Old Style is 0---. Now, in a Line with the Foot Line of the left hand Division, right under 1, you

Jane

Find Monday, the Day sought. — But if two Days more were cut off, the first Day would be the 3d; and if the third were made to fall on Monday, the first would fall on Saturday, the Day on which the Vulgar Christian Æra will, upon computation, be found to have begun: — though it is likewise said to be Erroneous.

A Table shewing the Dominical Letter both for the Julian and the Gregorian Account. For the Use of this Table, see Page 69 at this mark ✠

Epact	1	2	3	4	5	6	7
1	C B	D C	E D	F E	G F	A G	B A
2	A	B	C	D	E	F	G
3	G	A	B	C	D	E	F
4	F	G	A	B	C	D	E
5	E D	F E	G F	A G	B A	C B	D C
6	C	D	E	F	G	A	B
7	B	C	D	E	F	G	A
8	A	B	C	D	E	F	G
9	G F	A G	B A	C B	D C	E D	F E
10	E	F	G	A	B	C	D
11	D	E	F	G	A	B	C
12	C	D	E	F	G	A	B
13	B A	C B	D C	E D	F E	G F	A G
14	G	A	B	C	D	E	F
15	F	G	A	B	C	D	E
16	E	F	G	A	B	C	D
17	D C	E D	F E	G F	A G	B A	C B
18	B	C	D	E	F	G	A
19	A	B	C	D	E	F	G
20	G	A	B	C	D	E	F
21	F E	G F	A G	B A	C B	D C	E D
22	D	E	F	G	A	B	C
23	C	D	E	F	G	A	B
24	B	C	D	E	F	G	A
25	A G	B A	C B	D C	E D	F E	G F
26	F	G	A	B	C	D	E
27	E	F	G	A	B	C	D
28	D	E	F	G	A	B	C
Annu	1582 1600	1700	1800	1900 2000	2100	2200	2300 2400
Chr:	2500	2600	2700 2800	2900	3000	3100 3200	3300

Chronological Remarks

Chronology is a Science which has for its Subject the Doctrine of Time.

Time is the Duration of Things and is measured by estimated by certain Motions, either equal, as Clocks, Watches, &c. or unequal, as of the Sun or other Heavenly Bodies; and this is called Apparent or Vulgar Time. The parts of Time are Minutes, Hours, Days, Weeks, Months, Years, Ages, Cycles, and Periods.

A Year is the Space, or Part of Time, or Duration measured by one entire Revolution of some Celestial Body in its Orb, Viz the Sun or Moon.

That which is measured out by the Revolution of the Sun in the Ecliptic, is called the Solar Year; and this is properly the Natural or Tropical Year, which contains 365 Days, 5 Hours, 48'. and 57".

But the Space of Time in which the Sun departing from any fixed Star, comes to it again, is called the Sydereal Year, which contains 365 Days, 6 Hours, 9'. 14".

The Lunar Year, is the Space of Time, in which the Moon performs 12 compleat Revolutions about the Earth, called Lunations; & contains 354 Days, 8 Hours, 48'. 38".

Years are distributed into Astronomical & Civil; the Astronomical Year is that which results from, or depends on the Principles of Astronomy: Such as are those above described. For the Tropical Year depends on one of the Cardinal Points, Viz the Equinox or Solstice; and the Sydereal Year on a fixed Star; and both on Astronomical Observation and Calculation.

The Civil Year is that in common Use among the several Nations of the World; it is either Solar or Lunar. The Civil Solar Year is again either Common or Bissextile. The Common Year is reckoned to contain only 365 Days, the odd Hours & Minutes being here neglected.

The Bissextile Year, otherwise called Leap Year, consisteth of 366 Days; the Day over & above the Common Year being called the Intercalary or Bissextile Day.

This Intercalation of a Bissextile Day was first appointed

By

By Julius Cæsar, to be made every fourth Year, to the end the Civil Year might keep pace with the Tropical Year. For the Six Hours, whereby the latter exceeded the former, in four Years make a whole Day; which therefore was then added to the 23d of February, which was the sixth of the Calends of March in the Roman Calendar. In this Year therefore they reckoned that sixth Day twice (in Latin Bis sextus Dies) and thence came the Name Bissextile for Leap-Year. But in our Almanacks we add that Intercalary Day at the end of the said Month, every 4th Year.

The Civil Lunar Year is Common or Embolimic. The Common Lunar Year consists of 12 Lunations, which are finished in 354 Days, at the end of which the Year begins again. The Embolimic Year was that wherein a Month was intercalated, to adjust the Lunar to the Solar Year. This Intercalation or Embolism was used by the Jews, who went by the Lunar Motions in their Accounts.

The Romans also at first used this Embolimic Lunar Year, as was settled by Romulus their first King, & consisted only of 10 Months, or 304 Days; and thus coming short of the true Lunar Year by 50 Days, and of the Solar Year by 61, this Year became vague & unfixed: Which Numa Pompilius, the second King, observing, added two other Months, January and February, and thereby made the Year consist of 12 Months, or 355 Days. But this Improvement not being sufficient to adequate the Year to the Motion of the Sun & Moon, and keep the Seasons even and steady Julius Cæsar instituted the Civil Solar Year, by adding 10 Days to every Common Year of Numa's and one Day extraordinary to every fourth Year, as aforesaid. This therefore was ever since called the Julian Year or Account, and Old Stile, which was still used in Britain till September 1752, as will be afterwards taken Notice of.

But since the Julian Year of 365 Days & 6 Hours exceeds the true Solar Year by 11 Minuts, this Excess in 131 Years amounts to one Day; and in the time of Pope Gregory XIII was grown into 10 Days. The Nicene Council A. D. 325 having fixed Easter to the next Sunday after the Full Moon, which came next after the Vernal Equinox, which was then on the 20th of March,

It

It happened that in the Year of our Lord 1582 Pope Gregory obser-
:ved, that the said fault of the Julian Year had cast the Equinoxes 10 Days,
and the Full Moon's 4 Days more backward, than they were at the time
of the said Council. Viz. to the 11th of March, & 5th of April. Thus the
Feast of Easter, and consequently all other Moveable Feasts, became un-
:fixed, and attended with great Disorder. To remedy this, the Pope ordered
10 Days to be taken from October that Year, that thus the Equinox might
be reduced to the 21st of March; and to keep it there, ordered, that, since
in the Julian Account every 100th Year is a Bissextile, & so 4 in 400
Years, in the Ages to come, 3 of those 4 Leap-Years should be changed
to common Years, and that only one 100th Year in every 4 Centuries
should conclude with a Bissextile. This Correction adjusts the
Years & Seasons near the truth, and is called the Gregorian Account,
or New Stile, which, since the Year 1700, comes to be 11 Days before
the Old Stile, or Julian Account used in Great Britain till 1752,
that the Calendar was corrected according to the New Stile, and
Tables and Rules framed for regulating Easter and the Moveable
Feasts depending thereon by an Act of Parliament, an Abstract where-
:of is on the Page immediately preceeding a Copy of the said Tables
and Rules in this Book.

The first and principal Division of the Year is into Parts we call
Months; and these are of as many kinds as are the Years of which they are
Parts: Viz Astronomical and Civil. The Astronomical Month, which is
also the Natural one, is either properly a Lunar Month, or the Space in
which the Moon runs through the Zodiac; and is either (1.) Synodical, called
a Lunation, which is the time contained between the Moon's parting from
the Sun at a Conjunction, and returning to him again; which is 29 Days
12 H. 44'. 3". (2.) Periodical Month, which the space of time wherein the
Moon makes one compleat Revolution, or returns to the same Point of
the Zodiac whence she departed; this contains 27 D. 7 H. 43'. 8". (3.) The
Illuminative Month is the time between the Appearance of two New
Moon's next each other, or the time a Moon is observed to shine; which
is always Variable.

The Solar Month is improperly thus called, as being only the Space of Time in which the Sun runs thro' one Sign of the Zodiac: Which Months, one with another, contain each 30 D. 10 H. 29'. 5".

Civil Months are those which are ~~framed~~ framed to serve the uses of Civil Life; and are different in different Nations & Countries in the World. These come very near the Quantity of Astronomical Months, both Lunar and Solar: Whence came the Distinction of Civil Lunar & Civil Solar Months. A Civil Lunar Month consisteth alternatly of 29 and 30 Days thro' the Year. Those of 29 were called Cavi, or Hollow; and those of 30, Pleni, or Full. Civil Solar Month consisted Alternately of 30 and 31 Days; except one of the 12, which every 4th Year was to have 29 Days, in others 28 only.

The Names, Quantities, &c. of the Civil Months used by several Nations to comprise their Calendars, may be seen in the following Tables.

No.	Julian Year.	Days	The Antient Roman Year.	Days.	The Antient Grecian Year.	Days.
1	January	31	Januarius	29	Hecatombæon	29
2	February	28	Februarius	28	Metagitnion	30
3	March	31	Martius	31	Boëdromion	29
4	April	30	Aprilis	29	Mœmacterion	30
5	May	31	Maius	31	Pyanepsion	29
6	June	30	Junius	29	Posideon	30
7	July	31	Quintilis	31	Gamelion	29
8	August	31	Sextilis	29	Anthesterion	30
9	September	30	September	29	Elaphebolion	29
10	October	31	October	31	Munychion	30
11	November	30	November	29	Thargelion	29
12	December	31	December	29	Scirrhophorion	30
	Days in Year	365	Days in Year	355	Days in Year	354
	This is a Solar Year, and there remains 5 Hou: & 49 Minutes forward on an Intercalar Day for Bissextile or Leap Year		This was ye Year wch first began wth Martius, till Nu: ma added 2 more Months, January & February; and after Julius Cæsar added 10 Days to equate it to ye Solar Year		This is a Lunar Year used at Athens, & require 11 D: 5 H: 49' to equate it with the Solar Year.	

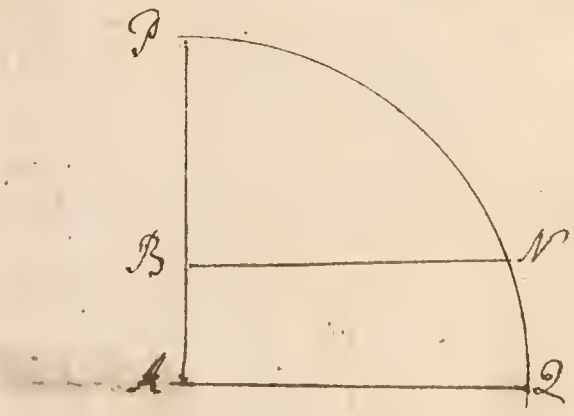
№	The Jewish Civil Year.	Days	The Syrian Year.	Days	The Arabick and Turkish Year.	Days
1	Tisri	30	Tishrin I.	31	Muharram	30
2	Marcheſoan	29	Tishrin II.	30	Sphar	29
3	Caslew	30	Canun I.	31	Rabia I.	30
4	Tebeth	29	Canun II.	31	Rabia II.	29
5	Shebet	30	Shabat	28	Jomada I.	30
6	Adar	29	Adar	31	Jomada II.	29
7	Nisan	30	Nigan	30	Rajab	30
8	Jiar	29	Aiyar	31	Shaaban	29
9	Sivan	30	Haziran	30	Samadan	30
10	Tamuz	29	Tamuz	31	Shaval	29
11	Ab	30	Ab	31	Dulkaadah	30
12	Elul	29	Elul	30	Dulheggia	29
	Days in Year	354	Days in Year	365	Days in Year	354
	In the Embolimick Year after Adar they add the Month Ve Adar of 30 Days.		This is equal to our Julian Year.		This Year is Lunar & the same to the Grecian and Jewish Year	

№	The Persian Year.	Days	The Egyptian Year.	Days	The Ethiopian Year.	Days
1	Avrudiah Meh	30	Thoth	30	Maxcaran	30
2	Ardihaſcht Meh	30	Paophi	30	Tykymt	30
3	Cardi Meh	30	Athyr	30	Hydar	30
4	Thir Meh	30	Chojac	30	Tychas	30
5	Merdid Meh	30	Tybi	30	Tyr	30
6	Schabarir Meh	30	Mechir	30	Jacatit	30
7	Mehar Meh	30	Phamenoth	30	Magabit	30
8	Aben Meh	30	Parmuthi	30	Miazia	30
9	Adar Meh	30	Pachon	30	Ginbat	30
10	Di Meh	30	Paunii	30	Syne	30
11	Behen Meh	30	Epiphi	30	Hamle	30
12	Aſſirer Meh	30	Mesori	30	Hahaſe	30
	Musterakas	5	Epagomena	5	Pagomen	5
	Days in Year	365	Days in Year	365	Days in Year	365

For the rest of Chronology, Vide Page

As the Earth is of a Spherical figure, and as the Meridians constantly approximate each other from the Equator till they coincide in the Poles; it follows that a Degree of Longitude on any Parallel of Latitude will be shorter than a Degree on the Equator, and the nearer we approach either of the Poles, the shorter will be a Degree of Longitude.

For let P N 2 be a Quadrant of the Meridian, B N the Radius or Semidiameter of any Parallel of Longitude; then, if the Quadrant P N 2 be turned round its Axis P A, the points 2 and N will describe two circles, which will be in the same proportion to each other, as the Radiuses A 2 and B N.



But A 2, the Radius of the Equator, is the Sine of the Arch P 2, and B N, the Radius of the Parallel, is the Sine of the Arch P N, or Complement of the Latitude of the Place N; whence it follows that the Circumference or Length of any Parallel is to the circumference or Length of the Equator; as the Co-sine of the Latitude is to the Radius.

And, since similar parts have the same proportion with their wholes, it follows, that a Length of a Degree of Longitude on the Equator is to the Length of a Degree of Longitude on any Parallel, as the Radius to the Co-sine of the Latitude.

And from this Proportion the following Table on the next page, taken out of the Universal Dictionary, is calculated.

A Table shewing how many Minutes of the Equator makeeth a Degree of Longitude, at every Degree of Latitude from the Universal Dictionary.

D. L.	Miles	D. L.	Miles.	D. L.	Miles	D. L.	Miles.	D. L.	Miles.
1	59,99	19	56,73	37	47,92	55	34,41	73	17,54
2	59,97	20	56,38	38	47,28	56	33,55	74	16,53
3	59,92	21	56,01	39	46,62	57	32,67	75	15,52
4	59,86	22	55,63	40	45,93	58	31,79	76	14,51
5	59,77	23	55,23	41	45,28	59	30,90	77	13,50
6	59,67	24	54,81	42	44,75	60	30,00	78	12,48
7	59,56	25	54,38	43	43,88	61	29,09	79	11,45
8	59,42	26	53,93	44	43,16	62	28,17	80	10,42
9	59,26	27	53,46	45	42,43	63	27,24	81	9,38
10	59,08	28	52,97	46	41,68	64	26,30	82	8,35
11	58,89	29	52,47	47	40,92	65	25,36	83	7,32
12	58,68	30	51,96	48	40,15	66	24,41	84	6,84
13	58,46	31	51,43	49	39,36	67	23,45	85	5,23
14	58,22	32	50,88	50	38,57	68	22,48	86	4,18
15	57,95	33	50,32	51	37,76	69	21,50	87	3,14
16	57,67	34	49,74	52	36,94	70	20,52	88	2,09
17	57,37	35	49,15	53	36,11	71	19,54	89	1,05
18	57,06	36	48,54	54	35,26	72	18,55	90	0,00

As this Table is calculated only to whole Degrees, therefore when the length of a Degree of Longitude is required on a Parallel of Latitude, consisting of Degrees & Minutes, we must use the following proportion, Viz. As 1 Degree = 60 Minutes is to the difference between the Minutes answering to a Degree, in the next greater and next less Tabular Latitude; so is the excess of the proposed Latitude above the next less Tabular Latitude, to a proportional part; which being subtracted from the Miles answering to a Degree of Latitude, in the next greater Tabular Latitude, will give the Minutes answering to a Degree of Longitude on the proposed Parallel.

A Table shewing how many Miles go to a Degree of Longitude in any Parallel of Latitude According to Gordon's Introd: to Geog: &c.

Lat:	M:	S:	Lat:	M:	S:	Lat:	M:	S:	Lat:	M:	S:
0	60	00	23	55	12	46	41	40	69	21	32
1	59	50	24	54	48	47	41	00	70	20	32
2	59	54	25	54	24	48	40	08	71	19	32
3	59	52	26	54	00	49	39	20	72	18	32
4	59	50	27	53	28	50	38	32	73	17	32
5	59	46	28	53	00	51	37	44	74	16	32
6	59	40	29	52	26	52	37	00	75	15	32
7	59	37	30	51	56	53	36	08	76	14	32
8	59	24	31	51	24	54	35	26	77	13	32
9	59	10	32	50	52	55	34	24	78	12	32
10	59	00	33	50	20	56	33	32	79	11	28
11	58	52	34	49	44	57	32	40	80	10	24
12	58	40	35	49	08	58	31	48	81	9	20
13	58	28	36	48	32	59	31	00	82	8	20
14	58	12	37	47	56	60	30	00	83	7	20
15	58	00	38	47	16	61	29	04	84	6	12
16	57	40	39	46	36	62	28	08	85	5	12
17	57	20	40	46	00	63	27	12	86	4	12
18	57	04	41	45	16	64	26	16	87	3	12
19	56	44	42	44	36	65	25	20	88	2	04
20	56	24	43	43	52	66	24	24	89	1	04
21	56	00	44	43	08	67	23	28	90	0	00
22	55	36	45	42	24	68	22	32			

A Table shewing the Parallel of Latitude, and the length of the Day in every Climate. According to Gordon's Introd: to Geog:

	Clim: between ye Eq: & Polar Circles.				Clim: between ye Eq: & Polar Circles.			
	Length of Day				Length of Day			
	H. M.				H. M.			
0	12..00	00..00	14	19..00	0	00..00	00..00	12..00	13	59..59	1..33	18..30
1	12..30	08..25	15	19..30	1	08..34	08..34	12..30	14	61..18	1..19	19..00
2	13..00	16..25	16	20..00	2	16..43	08..09	13..00	15	62..25	1..07	19..30
3	13..30	23..30	17	20..30	3	24..11	07..28	13..30	16	63..28	0..58	20..00
4	14..00	20..30	18	21..00	4	30..47	06..36	14..00	17	64..16	0..53	20..30
5	14..30	36..28	19	21..30	5	36..30	05..43	14..30	18	64..55	0..39	21..00
6	15..00	41..22	20	22..00	6	41..22	04..52	15..00	19	65..25	0..30	21..30
7	15..30	45..29	21	22..30	7	45..29	04..07	15..30	20	65..41	0..22	22..00
8	16..00	49..01	22	23..00	8	49..01	03..32	16..00	21	66..06	0..19	22..30
9	16..30	51..58	23	23..30	9	51..58	02..51	16..30	22	66..20	0..14	23..00
10	17..00	54..27	24	24..00	10	54..29	02..31	17..00	23	66..28	0..08	23..30
11	17..30	56..37			11	56..37	02..12	17..30	24	66..21	0..03	24..00
12	18..00	58..29			12	58..26	01..40	18..00				
13	18..30	59..58										

Clim: between ye Po: circles & ye Poles						
	1	2	3	4	5	6
	° ′	° ′	° ′	° ′	° ′	° ′
	67..15	69..30	73..20	78..20	84..10	90..0

A Table shewing the Parallel of Latitude, the Breadth, and the Length of the Day in every Climate. According to Martin.

	Climates between ye Equator and the Polar Circles.				Climates between ye Polar Circles and the Poles			
	Length of Day				Length of Day			
	H. M.				H. M.			
1	67..31	1..00	1 Month		4	78..20	5..00	4 Months
2	69..31	2..00	2 Months		5	84..00	5..40	5 Months
3	73..21	3..50	3 Months		6	90..00	6..00	6 Months

To convert Degrees, and Minuts &c of the Equinoctial into Time, and Vice versa.

Since the Equator (as all great Circles are) is divided into 360 Degrees, each Hour must be 1/24 of that Number, or 15 Degrees; therefor 1 Degree of the Equator will contain 4 Minutes of an Hour; & 15 Minuts of a Degree will make 1 Mininut of an Hour or 60 Seconds; and consequently 4 Seconds answer to one Minute of a Degree. Hence the following Tables are made.

To convert parts of the Equinoctial into Time.

Degrees	Hours.	'
Minuts.	'	''
Seconds.	''	'''
Thirds.	'''	''''

1	0	04
2	0	08
3	0	12
4	0	16
5	0	20
10	0	40
15	1	00
30	2	0
60	4	0
90	6	0
180	12	0
360	24	0

To convert time into parts of the Equinoctial.

Hours	Degrees.	Minuts.	Degrs	'
		Seconds	'	''
		Thirds	''	'''
		Fourths.	'''	''''

1	15	1	0	15
2	30	2	0	30
3	45	3	0	45
4	60	4	1	0
5	75	5	1	15
6	90	6	1	30
9	135	10	2	30
12	180	20	5	00
15	225	30	7	30
18	270	40	10	00
21	315	50	12	30
24	360	60	15	0 0

How many Hours, Minuts & Seconds &c. are there in 19° 13' 7" of the Equator?

	H:	'	''	'''
Against 15° you'll find	1	0	0	0
Against 4°	0	16	0	0
Against 10'	0	0	40	0
Against 3'	0	0	12	0
Against 5''	0	0	00	20
Against 2''	0	0	0	8
Sum	1	16	52	28

How many Degr: Min: Se: &c of the Equator are there in 23 Ho: 25 Min: 17 Se: & 9 Thirds?

	°	'	''	'''
Against 21 Hours you find	315	0	0	0
Against 2 Hours	30	0	0	0
Against 20'	5	0	0	0
Against 5'	1	15	0	0
Against 10''	0	0	2	30
Against 5''	0	1	15	0
Against 2''	0	0	30	0
Against 6'''	0	0	0	1 30
Against 3'''	0	0	0	45
Sum	351	19	17	15

The Continent of Europe.

No.	Nations.	Lat:	Long^t:	Length	Breadth	Climate	Chief City.	Lat:	Long^t
		° ′	° ′					° ′	° ′
1	Norway.	57..00 72..00	22..00 50..00	1600	300	11..12 13. &c	Bergen.	61..00	24..15
2	Sweden	56..00 69..00	32..00 55..00	660	780	9.10 11. 12	Stockholm	59..26	39..05
3	Denmark	26..00 34..00	54..30 58..00	270	180	10. 11.	Copenhagen.	56..13	32..30
4	Muscovy	45..10 71..00	46..00 105..00	1630	1500	8.9.10. 11.12.13.	Moscow.	55..26	63..00
5	Germany.	45..30 54..30	24..10 37..12	540	510	7. 8. 9.10	Vienna.	48..14	37..05
6	Poland.	48..00 58..20	34..30 53..30	780	600,	9.10.11.	Cracow.	49..56	40..47
7	France.	42..30 51..10	12..10 26..30	520	450	6.7.8.	Paris.	48..45	21..30
8	Spain.	36..15 44..30	08..05 21..30	620	480	5&6. 7.	Madrid.	40..25	13..40
9	Italy.	38..15 46..30	25..30 39..00	760	134	6.7	Rome.	41..51	34..20
10	Turkey in Europe	36..30 49..20	36..00 53..00	770	660	5. 6. 7. 8.	Constantinople.	43..00	54..20

The Continent of Asia.

No.	Nations.	Lat:	Long^t.	Length	Brdth	Climate	Chief City.	Lat.	Long^t
		° ′	° ′					° ′	° ′
1	Tartary.	31..30 74..04	71..10 163..00	3000	2250	6 to 21	Cambalu.	*	
2	China.	20..30 41..10	118..00 141..00	1380	1200	3.4. 5.6.	Peking.	39..40	133..36
3	India.	08..12 40..00	92..00 131..00	1680	1690	2.3.4. 5. 6.	Agra.	26..30	98..20
4	Persia	25..40 44..30	70..30 91..00	1440	1260	4. 5. 6.7.	Ispahan.	31..45	69..30
5	Natolia	35..00 44..00	482..00 68..00	720	400	6.7.	Bursa.	41..49	51..30
6	Arabia.	12..00 34..00	53..00 80..00	1380	1080	2.3 4.6.	Medina.	24..50	59..10
7	Syria.	33..30 38..30	61..00 69..30	560	200	5. 6.	Aleppo.	36..10	56..30
8	Euphrat. Provinces						Bagdat.	33..30	62..30

The Continent of Africa.

No	Nations.	Lat:	Long^t	Length.	Breadth.	Climate	Chief City	Lat:	Long^t
1	Egypt.	21°..10' 30..00	52°..6' 62..40	650	310	3.4	Cairo.	29°..40'	51°..30'
2	Barbary.	24..40 35..00	04..16 52..10	2300	380	4.5.	Fez.	33..30	14..00
3	Bildulgerid	22..30 32..40	2..00 55..00	2040	300	4.5	Daiea.	27..00	08..42
4	Zaara	21..00 28..00	2..00 50..00	2340	330	3.4	Segafsa.	21..51	06..00
5	Negroland	10..00 23..10	00..10 46..20	2280	600	2.3	Tombut.	14..50	08..30
6	Guinea.	04..10 11..40	03..00 30..00	1320	360	1.2	Benin.	07..30	05..05
7	Nubia.	09..30 23..00	32..00 57..00	840	570	2.3	Dancala.	17..30	52..00
8	Ethiopia Inf:	9 N.00 35 S.00	35..00 45..00	2640	900	1 N.to 5 S.	Monomotapa.	25..45	39..00
9	Ethiopia Sup:	24 S.00 18 N.00	45..00 69..00	1200	750	3 N.to 3 S.			

The Continent of America.

No	Nations	Lat:	Long^t	Length.	Breadth.	Climate	Chief City.	Lat:	Long^t.
1	Mexico.	08°..50' 13..00	259°..00' 291..00	2520	480	2.3.4.	Mexico.	19..00	270..00
2	Granada.	27..00 40..00		1140	780	5.6	Sta Fee.	36..00	260..00
3	Florida.	26..50 40..00	276..0 291..00	1000	600	5.6.	Coca.		
4	Terra. Canadensis.	30..00 62..00	290..00 320..00	1500	1920	5 to 15.	Boston.	42.40	310..00
5	Terra Firma.	03..20 11..30	297..30 330..00	1260	480	1½.	Sta Fee de Bagota.	3..30	
6	Peru.	25..30 01..00	3 307..10	1440	480	1.2.3.	Lima.	12..20	
7	Lands off Amazons.	02 N..00 17 S..00							
8	Brazil.	1..00 23..00	322..00 346..30	1600	1380	1.2.3	S. Salvador	12..20.	
9	Chili.	25..30 44..00	306..00	960	480	4.5.6.	St Jago.	34.00	
10	Paraguay.	12..00 37..00	307..10 337..40	1560	1500	2.3. 4. 5.	Assumption.	25..30	

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The subdivisions of the Continents of Europe.

Norway is divided into five Governments.	Chief City.	Lattitude	Long^{t}
		° ′	° ′
Bahus	Bahus	58..14	31..40
Aggerhus	Anslo	60..30	29..00
Bergen	Bergen	61..00	24..15
Drontheim	Drontheim	65..24	30..35
Wardhus	Wardhus	70..45	52..00

Sweden comprehends Seven Countries.

Sweden proper	Stockholm	59..26	39..05
Gothland	Calmar	57..06	36..32
Schonen	Sunder	56..40	33..22
Lapland	Torneo	66..08	44..00
Finland	Abo	60..23	43..33
Ingria	Notteburg	59..52	34..00
Livonia	Riga	56..34	45..34

Denmark contains.

The Peninsula of Jutland comprehending	North Jutland	Wiborg	56..47	28..52
	South Jutland	Slesvick	55..57	29..24
The Isles of	Zeeland	Copenhagen	56..13	32..30
	Funen	Odenwe	55..52	30..10
And other small ones				

Muscovy or Russia contains.

Chief Southern Provinces	Smolensko	Smolenskow	54..31	55..42
	Novogrod Severskii	Novogrod Sev.	57..10	56..24
	Czernikow	Czernikow	51..48	55..00
	Ukrain	Kiow	50..42	53..20
	Woroslin	Woroslin	54..10	62..00
	Resan	Resan	54..30	65..05
	Moskow	Moscow	55..25	63..00
	Tver	Tver	56..35	60..20
	Rostow	Rostow	67..10	63..25

		Chief City.	Lat: ° ,	Long: ° ,
6. Jo: Pro:	Jaraslov	Jaraslov	57..35	63..30
	Susdal	Susdal	56..35	62..25
	Wolodimer	Wolodimer	51..00	67..10
Chief Northern Provinces	Muscovia Lapland	Kola	69..25	56..30
	Kargapol	Kargapol	61..25	64..10
	Dvina	Archangle	64..50	65..10
	Condora	Virgatoria		
	Obdora	Beresof		
	Permski	Perma-Weliki	62..34	81..40
	Nisi-Novogrod	Nisi-Novogrod	58..00	69..25
	Wologda	Wologda	59..05	65..10
	Novogrod-Weliki	Novogrod-Weliki	58..10	55..18
	Pleskov	Pleskov	57..25	50..30
Moscovia Asiatica	Samoieda			
	Siberia	Tobalskoy	58..15	81..50
	Dauri	Nerzinskoy	53..00	
	Kamsatka			
	Bulgaria	Bulgar		
	Astracan	Astracan	17..00	

Germany is divided into ten Circles.

Belgium	Holland	Amsterdam	52..29	24..00
	Flanders	Bruxelles	50..54	23..36
Westphalia		Munster	52..00	27..12
Lower Saxony		Hamburg	53..57	29..20
Upper Saxony		Wittenburg	51..54	33..02
Lower Rhine		Heidelberg	49..17	25..27
Upper Rhine		Francfort	50..03	28..12
Franconia		Nuremburg	49..24	31..11
Suabia		Ausburg	48..14	37..57
Bavaria		Munich	41..58	31..36
Austria		Vienna	48..14	37..05

Poland contains the following Provinces &c.

The Dukedom of Lithuania	Wilna	54..31	47..14
The Province of Volhinia	Kiow	50..42	53..20
The Province of Podolia	Caminieck	48..50	47..46
The Dukedom of Curland	Mittaw	57..00	44..00

	Chief City.	Lat. ° '	Long. ° '
The Dukedom of Samogitia	Rosinie	55..15	44..48
The Province of Polaquia	Bielha	55..36	56..35
The Province of Lille Russia	Lemberg	49..36	45..00
The Kingdom of Prussia	Dantzick	54..13	40..42
The Dukedom of Warsovia	Warsaw	52..07	42..05
Proper Polonia	Cracow	49..56	40..47

France contains Twelve Governments.

Picardy	Amiens	49..54	21..26
Normandy	Rouen	49..26	20..02
Isle of France	Paris	48..48	21..30
Champaigne	Troyes	48..07	23..17
Britanny	Rennes	48..03	16..30
Orleanois	Orleans	47..44	20..42
Bourgundy	Dijons	43..37	24..05
Lionois	Lions	45..24	24..08
Guinne and Gascony	Bourdeaux	44..50	W..50
Languedoc	Thoulouse	43..29	19..48
Dauphiné	Grenoble	44..54	25..04
Provence	Aix	43..04	24..40

Spain with Portugal contains.

The Lordship of * Biscay	Bilboa	43..41	14..22
The Principality of * Asturia	Oviedo	43..23	11..05
The Kingdom of Gallicia	Compostella	43..00	08..16
The Kingdom of * Portugal	Lisbon	38..45	07..37
The Kingdom of * Algarve	Tavira	37..00	09..14
The Province of Andalusia	Seville	37..30	11..14
The Kingdom of Granada	Granada	37..28	13..55
The Kingdom of Murcia	Murcia	38..04	16..34
The Kingdom of Valentia	Valence	39..25	17..15
The Principality of * Catalonia	Barcelona	40..34	20..33
The Kingdom of Arragon	Saragosa	41..35	17..00
The Kingdom of Navarre	Parhpelona	42..52	16..06
The Province of Old Castile	Burgos	46..55	21..14
The Province of New Castile	Madrid	40..25	13..40
The Kingdom of Leon	Leon	42..44	11..08

Italy contains the Dominions of.

	Chief City.	Lat.	Long.
		° ′	° ′
The Church, or Peter's Patri:	Rome	41..51	34..20
The Kingdom of Naples	Naples	40..56	36..15
The Dutchy of Milan	Milan	44..56	29..13
The Republic of Venice	Venice	45..20	34..04
The Dukedom of Savoy	Chambery	45..04	25..24
The Principality of Piedmont	Turin	44..34	27..26
The Dukedom of Tuscany	Florence	43..20	32..10
The Republic of Genoa	Genoa	43..53	29..00
The Dukedom of Mantua	Mantua	44..52	31..10
The Dukedom of Montferrat	Casale	44..40	28..17
The Dukedom of Modena	Modena	44..14	31..32
The Dukedom of Reggio	Reggio	44..18	31..04
The Dukedom of Parma	Parma	44..24	30..40
The Dukedom of Piacentia	Piacenza	39..48	11..50
The Dukedom of Massa	Massa	43..24	30..36
The Dukedom of Mirandola	Mirandola	44..35	31..38
The Republic of Lucca	Lucca	43..13	31..38
The Bishoprick of Trent	Trent	45..48	31..24

Turkey in Europe comprehends.

*Hungary	Buda	47..38	40..15
Transilvania	Hermanstat	46..46	45..48
Walachia	Targovisco	45..54	47..38
Moldavia	Soczow	47..44	48..30
Little Tartary	Kaffa	47..20	61..21
Romania	Constantinople	43..00	54..20
Bulgaria	Sophia	43..25	47..12
Servia	Belgrade	45..20	42..34
Bosnia	Saraio	44..54	40..30
Sclavonia	Posega	45..46	39..42
Croatia	Wihitz	45..18	37..44
Dalmatia	Spalatro	44..00	38..50
Greece	†Salonichi	41..37	41..00

* The Emperor [illegible] of Germany.

† [illegible] of Salonichi.

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The Sun's mean Longitude, Motion, and Anomaly: Old stile.

Years begun	Sun's mean Longitude. S.	°	'	"	Sun's mean Anomaly. S.	°	'
1	9	7	53	10	6	28	48
201	9	9	23	50	6	26	57
301	9	10	9	10	6	26	1
401	9	10	54	30	6	25	5
501	9	11	39	50	6	24	9
1001	9	13	26	30	6	19	32
1101	9	16	13	50	6	18	36
1201	9	16	57	10	6	17	40
1301	9	17	42	30	6	16	44
1401	9	18	27	50	6	15	49
1501	9	19	13	10	6	14	53
1601	9	19	58	30	6	13	57
1701	9	20	43	50	6	13	1
1801	9	21	29	10	6	12	6

Years compleat	Sun's mean Motion. S.	°	'	"	Sun's mean Anomaly. S.	°	'
1	11	29	45	40	11	29	45
2	11	29	31	20	11	29	29
3	11	29	17	0	11	29	14
4	0	0	1	49	11	29	58
5	11	29	47	29	11	29	42
6	11	29	33	9	11	29	27
7	11	29	18	49	11	29	11
8	0	0	3	38	11	29	55
9	11	29	49	18	11	29	40
10	11	29	34	58	11	29	24
11	11	29	20	38	11	29	9
12	0	0	5	26	11	29	53
13	11	29	51	7	11	29	37
14	11	29	36	47	11	29	22
15	11	29	22	27	11	29	7
16	0	0	7	15	11	29	56
17	11	29	52	55	11	29	35
18	11	29	38	35	11	29	20
19	11	29	24	16	11	29	4
20	0	0	9	4	11	29	48
40	0	0	18	8	11	29	34
60	0	0	27	12	11	29	26
80	0	0	36	16	11	29	15

Years compleat	Sun's mean motion S.	°	'	"	Sun's mean Anomaly S.	°	'
100	0	0	45	20	11	29	4
200	0	1	30	40	11	28	8
300	0	2	16	0	11	27	12
400	0	3	1	20	11	26	16
500	0	3	46	40	11	25	21
600	0	4	32	0	11	24	25
700	0	5	17	20	11	23	29
800	0	6	2	40	11	22	33
900	0	6	48	0	11	21	37
1000	0	7	33	20	11	20	41
2000	0	15	6	40	11	11	22
3000	0	22	40	0	11	2	3
4000	1	0	13	20	10	22	44
5000	1	7	46	40	10	13	25
6000	1	15	20	0	10	4	6

Months	Sun's mean Motion. S.	°	'	"	Sun's mean Anomaly S.	°	'
Jan:	0	0	0	0	0	0	0
Feb:	1	0	33	18	1	0	33
Mar:	1	28	9	11	1	28	9
April	2	28	42	30	2	28	42
May	3	28	16	40	3	28	17
June	4	28	49	58	4	28	50
July	5	28	24	8	5	28	24
Aug:	6	28	57	26	6	28	57
Sept:	7	29	30	49	7	29	30
Oct:	8	29	4	54	8	29	4
Nov:	9	29	38	12	9	29	37
Dec:	10	29	12	22	10	29	11

Days	Sun's mean Motion and Anomaly.				Sun's mean Motion and Anomaly				Sun's mean Diff. from Node				Sun's mean Motion and Anomaly.				Sun's mean Dist. from Node			
					H.								H.							
					m								m							
	ſ				ſ				ſ				ſ				ſ			
	ſ	o	′	″	ſ	o	′	″	ſ	o	′	″	ſ	o	′	″	ſ	o	′	″
1	0	0	59	8	1	0	2	28	0	2	36		31	1	26	23	1	20	30	
2	0	1	58	17	2	0	4	56	0	5	12		32	1	28	31	1	23	6	
3	0	2	57	25	3	0	7	29	0	7	48		33	1	25	40	1	25	42	
4	0	3	56	33	4	0	9	51	0	10	23		34	1	23	47	1	28	18	
5	0	4	55	42	5	0	12	19	0	12	59		35	1	26	15	1	30	54	
6	0	5	54	50	6	0	14	47	0	15	35		36	1	28	42	1	33	29	
7	0	6	53	58	7	0	17	13	0	18	11		37	1	31	10	1	36	5	
8	0	7	53	7	8	0	19	43	0	20	47		38	1	33	38	1	38	40	
9	0	8	52	15	9	0	22	11	0	23	23		39	1	36	6	1	41	16	
10	0	9	51	23	10	0	24	38	0	25	58		40	1	38	34	1	43	52	
11	0	10	50	32	11	0	27	6	0	28	34		41	1	41	2	1	46	28	
12	0	11	49	40	12	0	29	34	0	31	10		42	1	43	30	1	49	4	
13	0	12	48	48	13	0	32	2	0	33	45		43	1	45	57	1	51	39	
14	0	13	47	57	14	0	34	30	0	36	21		44	1	48	25	1	54	15	
15	0	14	47	5	15	0	36	58	0	38	57		45	1	50	53	1	55	51	
16	0	15	46	13	16	0	39	26	0	41	33		46	1	53	21	1	59	27	
17	0	16	45	22	17	0	41	53	0	44	8		47	1	55	49	2	2	3	
18	0	17	44	30	18	0	44	21	0	46	44		48	1	58	17	2	4	39	
19	0	18	43	38	19	0	46	49	0	49	20		49	2	0	44	2	7	13	
20	0	19	42	47	20	0	49	17	0	51	56		50	2	3	12	2	9	50	
21	0	20	41	55	21	0	51	45	0	54	32		51	2	5	40	2	12	25	
22	0	21	41	3	22	0	54	13	0	57	8		52	2	8	8	2	15	2	
23	0	22	40	12	23	0	56	40	0	59	43		53	2	10	36	2	17	38	
24	0	23	39	20	24	0	59	8	1	2	19		54	2	13	4	2	20	14	
25	0	24	38	28	25	1	1	36	1	4	55		55	2	15	32	2	22	50	
26	0	25	37	34	26	1	4	4	1	7	31		56	2	17	59	2	25	26	
27	0	26	36	45	27	1	6	32	1	10	7		57	2	20	27	2	28	2	
28	0	27	35	53	28	1	9	0	1	12	43		58	2	22	55	2	30	38	
29	0	28	35	2	29	1	11	28	1	15	19		59	2	25	23	2	33	14	
30	0	29	34	10	30	1	13	55	1	17	55		60	2	27	51	2	35	60	
31	1	30	33	18																

In Leap-years, after February, adel one day, and one day's motion.

0 ♈ 1 ♉ 2 ♊ 3 ♋ 4 ♌ 5 ♍ 6 ♎

7 ♏ 8 ♐ 9 ♑ 10 ♒ 11 ♓ .

Equation of the Sun's center; or the difference between his mean and true Place.

Argument. Sun's mean Anomaly.

Subtract

	0 Signs	1 Signs	2 Signs	3 Signs	4 Signs	5 Signs	
	0 - 1 - 11	0 - 1 - 11	0 - 1 - 1	0 - 1 - 11	0 - 1 - 11	0 - 1 - 11	
0	0 - 0 - 0	0 - 56 - 47	1 - 39 - 6	1 - 55 - 37	1 - 41 - 12	0 - 58 - 53	30
1	0 - 1 - 59	0 - 58 - 30	1 - 40 - 7	1 - 55 - 39	1 - 40 - 12	0 - 57 - 7	29
2	0 - 3 - 57	1 - 0 - 12	1 - 41 - 6	1 - 55 - 38	1 - 39 - 10	0 - 55 - 19	28
3	0 - 5 - 56	1 - 1 - 53	1 - 42 - 3	1 - 55 - 36	1 - 38 - 6	0 - 53 - 30	27
4	0 - 7 - 54	1 - 3 - 33	1 - 42 - 59	1 - 55 - 31	1 - 37 - 0	0 - 51 - 40	26
5	0 - 9 - 52	1 - 5 - 12	1 - 43 - 52	1 - 55 - 24	1 - 35 - 52	0 - 49 - 49	25
6	0 - 11 - 50	1 - 6 - 50	1 - 44 - 44	1 - 55 - 15	1 - 34 - 43	0 - 47 - 57	24
7	0 - 13 - 48	1 - 8 - 27	1 - 45 - 34	1 - 55 - 3	1 - 33 - 32	0 - 46 - 5	23
8	0 - 15 - 46	1 - 10 - 2	1 - 46 - 22	1 - 54 - 50	1 - 32 - 19	0 - 44 - 11	22
9	0 - 17 - 43	1 - 11 - 36	1 - 47 - 8	1 - 54 - 35	1 - 31 - 4	0 - 42 - 16	21
10	0 - 19 - 40	1 - 13 - 9	1 - 47 - 53	1 - 54 - 17	1 - 29 - 47	0 - 40 - 21	20
11	0 - 21 - 37	1 - 14 - 41	1 - 48 - 35	1 - 53 - 57	1 - 28 - 29	0 - 38 - 25	19
12	0 - 23 - 33	1 - 16 - 11	1 - 49 - 15	1 - 53 - 36	1 - 27 - 9	0 - 36 - 28	18
13	0 - 25 - 29	1 - 17 - 40	1 - 49 - 54	1 - 53 - 12	1 - 25 - 48	0 - 34 - 30	17
14	0 - 27 - 25	1 - 19 - 8	1 - 50 - 30	1 - 52 - 46	1 - 24 - 25	0 - 32 - 32	16
15	0 - 29 - 20	1 - 20 - 34	1 - 51 - 5	1 - 52 - 18	1 - 23 - 0	0 - 30 - 33	15
16	0 - 31 - 15	1 - 21 - 59	1 - 51 - 37	1 - 51 - 48	1 - 21 - 34	0 - 28 - 33	14
17	0 - 33 - 9	1 - 23 - 22	1 - 52 - 8	1 - 51 - 15	1 - 20 - 6	0 - 26 - 33	13
18	0 - 35 - 2	1 - 24 - 44	1 - 52 - 36	1 - 50 - 41	1 - 18 - 36	0 - 24 - 33	12
19	0 - 36 - 55	1 - 26 - 5	1 - 53 - 3	1 - 50 - 5	1 - 17 - 5	0 - 22 - 32	11
20	0 - 38 - 47	1 - 27 - 24	1 - 53 - 27	1 - 49 - 26	1 - 15 - 33	0 - 20 - 30	10
21	0 - 40 - 39	1 - 28 - 41	1 - 53 - 50	1 - 48 - 46	1 - 13 - 59	0 - 18 - 28	9
22	0 - 42 - 30	1 - 29 - 57	1 - 54 - 10	1 - 48 - 3	1 - 12 - 24	0 - 16 - 26	8
23	0 - 44 - 20	1 - 31 - 11	1 - 54 - 28	1 - 47 - 19	1 - 10 - 47	0 - 14 - 24	7
24	0 - 46 - 9	1 - 32 - 25	1 - 54 - 44	1 - 46 - 32	1 - 9 - 9	0 - 12 - 21	6
25	0 - 47 - 57	1 - 33 - 35	1 - 54 - 58	1 - 45 - 44	1 - 7 - 29	0 - 10 - 18	5
26	0 - 49 - 45	1 - 34 - 45	1 - 55 - 10	1 - 44 - 53	1 - 5 - 49	0 - 8 - 14	4
27	0 - 51 - 32	1 - 35 - 53	1 - 55 - 20	1 - 44 - 1	1 - 4 - 7	0 - 6 - 11	3
28	0 - 53 - 18	1 - 36 - 59	1 - 55 - 28	1 - 43 - 7	1 - 2 - 24	0 - 4 - 7	2
29	0 - 55 - 3	1 - 38 - 3	1 - 55 - 34	1 - 42 - 10	1 - 0 - 39	0 - 2 - 4	1
30	0 - 56 - 47	1 - 39 - 6	1 - 55 - 37	1 - 41 - 12	0 - 58 - 53	0 - 0 - 0	0
	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	

Add

Table of the Sun's Declination

Arg: Sun's true place.

Arg.	Signs 0. N. 6. S.	Signs 1 N. 7 S.	Signs 2. N 8. S.	
Degrees	0..1	0..1	0..1	
0	0..0	11..30	20..11	30
1	0..24	12..51	20..24	29
2	0..48	12..11	20..36	28
3	1..12	12..32	20..48	27
4	1..36	12..53	20..59	26
5	1..59	13..13	21..10	25
6	2..23	13..33	21..21	24
7	2..47	13..53	21..31	23
8	3..11	14..12	21..41	22
9	3..34	14..31	21..50	21
10	3..58	14..50	21..59	20
11	4..22	15..9	22..8	19
12	4..45	15..28	22..16	18
13	5..9	15..46	22..24	17
14	5..32	16..4	22..31	16
15	5..55	16..22	22..38	15
16	6..18	16..39	22..45	14
17	6..41	16..57	22..51	13
18	7..4	17..14	22..56	12
19	7..27	17..30	23..2	11
20	7..50	17..46	23..6	10
21	8..13	18..2	23..11	9
22	8..35	18..18	23..14	8
23	8..57	18..33	23..18	7
24	9..20	18..48	23..21	6
25	9..42	19..3	23..23	5
26	10..4	19..17	23..25	4
27	10..25	19..31	23..27	3
28	10..47	19..45	23..28	2
29	11..6	19..58	23..29	1
30	11..30	20..11	23..29	0
Degrees	Signs 11 S. 5 N.	Signs 10 S. 4 N.	Signs 9 S. 3 N.	

Equation of the Sun's mean Distance from the Node

Argument. Sun's mean Anomaly Subtract

	0 Signs	1 Signs	2 Signs	3 Signs	4 Signs	5 Signs	Degrees.
0	0..0	1..2	1..47	2..5	1..50	1..4	30
1	0..2	1..4	1..48	2..5	1..48	1..2	29
2	0..4	1..6	1..49	2..5	1..47	1..0	28
3	0..6	1..8	1..50	2..5	1..46	0..58	27
4	0..9	1..10	1..51	2..5	1..45	0..56	26
5	0..11	1..12	1..52	2..5	1..44	0..54	25
6	0..13	1..14	1..53	2..5	1..43	0..52	24
7	0..15	1..16	1..54	2..4	1..41	0..50	23
8	0..17	1..17	1..55	2..4	1..40	0..48	22
9	0..19	1..18	1..56	2..4	1..39	0..46	21
10	0..21	1..19	1..57	2..4	1..37	0..44	20
11	0..23	1..21	1..58	2..3	1..36	0..42	19
12	0..25	1..22	1..58	2..3	1..34	0..40	18
13	0..28	1..24	1..59	2..3	1..33	0..37	17
14	0..30	1..26	2..0	2..2	1..31	0..35	16
15	0..32	1..27	2..0	2..2	1..30	0..33	15
16	0..34	1..28	2..1	2..1	1..28	0..31	14
17	0..36	1..30	2..1	2..1	1..27	0..29	13
18	0..38	1..31	2..2	2..0	1..25	0..27	12
19	0..40	1..34	2..2	2..0	1..24	0..24	11
20	0..42	1..35	2..3	1..59	1..23	0..22	10
21	0..44	1..36	2..3	1..59	1..21	0..20	9
22	0..46	1..37	2..4	1..58	1..19	0..18	8
23	0..48	1..39	2..4	1..57	1..17	0..16	7
24	0..50	1..40	2..4	1..56	1..15	0..13	6
25	0..52	1..41	2..4	1..55	1..13	0..11	5
26	0..54	1..43	2..5	1..54	1..11	0..9	4
27	0..56	1..44	2..5	1..53	1..9	0..7	3
28	0..58	1..45	2..5	1..52	1..8	0..5	2
29	1..0	1..46	2..5	1..51	1..6	0..3	1
30	1..2	1..47	2..5	1..50	1..4	0..0	0
	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

Add.

Table shewing the Days of the Months for both Stiles by the Dominical Letters.

Week-Day.	A	B	C	D	E	F	G
	1	2	3	4	5	6	7
January	8	9	10	11	12	13	14
31.	15	16	17	18	19	20	21
October	22	23	24	25	26	27	28
31.	29	30	31	—	—	—	—
	—	—	—	1	2	3	4
February	5	6	7	8	9	10	11
28—29.	12	13	14	15	16	17	18
March 31.	19	20	21	22	23	24	25
Novr. 30	26	27	28	29	30	31	—
	—	—	—	—	—	—	1
	2	3	4	5	6	7	8
April 30	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
July 31.	23	24	25	26	27	28	29
	30	31	—	—	—	—	—
	—	—	1	2	3	4	5
	6	7	8	9	10	11	12
August	13	14	15	16	17	18	19
31.	20	21	22	23	24	25	26
	27	28	29	30	31	—	—
	—	—	—	—	—	1	2
	3	4	5	6	7	8	9
Septemb.	10	11	12	13	14	15	16
30.	17	18	19	20	21	22	23
Decemb:	24	25	26	27	28	29	30
31.	31	—	—	—	—	—	—
	—	1	2	3	4	5	6
	7	8	9	10	11	12	13
May 31.	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31	—	—	—
	—	—	—	—	1	2	3
	4	5	6	7	8	9	10
June 30	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	

Table shewing the Number of Direction, for finding Easter by the Golden Numb: & Dom: Letter adapted to New Stile.

	A	B	C	D	E	F	G
1	26	27	28	29	30	24	25
2	19	13	14	15	16	17	18
3	5	6	7	8	2	3	4
4	26	27	21	22	23	24	25
5	12	13	14	15	16	10	11
6	33	34	35	29	30	31	32
7	19	20	21	22	23	24	18
8	12	13	7	8	9	10	11
9	26	27	28	29	30	31	32
10	19	20	21	15	16	17	18
11	5	6	7	8	9	10	4
12	26	27	28	29	23	24	25
13	12	13	14	15	16	17	18
14	5	6	7	1	2	3	4
15	26	20	21	22	23	24	25
16	12	13	14	15	9	10	11
17	33	34	28	29	30	31	32
18	19	20	21	22	23	17	18
19	12	6	7	8	9	10	11

	G	F	E	D	C	B	A
April. July.	Sun:	Mon:	Tues:	Wed:	Thur:	Frid:	Sat:
January. October.	Mon:	Tues:	Wed:	Thur:	Frid:	Sat:	Sun:
May.	Tues:	Wed:	Thur:	Frid:	Sat:	Sun:	Mon:
August.	Wed:	Thur:	Frid:	Sat:	Sun:	Mon:	Tues:
Feb: March. November.	Thur:	Frid:	Sat:	Sun:	Mon:	Tues:	Wed:
June.	Frid:	Sat:	Sun:	Mon:	Tues:	Wed:	Thur:
September. December.	Sat:	Sun	Mon:	Tues:	Wed	Thur:	Frid:
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31	•	•	•	•

B	A	G	F	E	D	C
1763	•	64	65	66	67	•
68	69	70	71	•	72	73
74	75	•	76	77	78	79
•	80	81	82	83	•	84
85	86	87	•	88	89	90
91	•	92	93	94	95	•
96	97	98	99	1800	1	2
3	•	4	5	6	7	•
8	9	10	11	•	12	13
14	15	•	16	17	18	19
•	20	21	22	23	•	24
25	26	27	•	28	29	30
31	•	32	33	34	35	•
36	37	38	39	•	40	41
42	43	•	44	45	46	47
•	48	49	50	51	•	52
53	54	55	•	56	57	58
59	•	60	61	62	63	•

Mar.	Aug.	May.	Oct.	Jul.	Sep.	Feb.
Nov:	*	Jan.	*	Ap.	Dec.	June.
1.	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	76	80	84	88
			Frid.	Wed.	Mon.	Sat:

Su.	Mo.	Tu.	We.	Th.	Fr	Sa.	May.		
Mo.	Tu.	We.	Th.	Fr.	Sa.	Su.	Aug.		
Tu.	We.	Th.	Fr.	Sa.	Su.	Mo.	Feb.	Mar.	Nov:
We.	Th.	Fr.	Sa.	Su.	Mo.	Tu.	June.		
Th.	Fr.	Sa.	Su.	Mo.	Tu.	We.	Sept.	Dec:	
Fr.	Sa.	Su.	Mo.	Tu.	We	Th.	Ap.	July	
Sa.	Su.	Mo.	Tu.	We.	Th.	Fr.	Jan.	Oct:	
1	2	3	4	5	6	7			
8	9	10	11	12	13	14			
15	16	17	18	19	20	21			
22	23	24	25	26	27	28			
29	30	31							

To find the Dominical Letter according to New Style

Rule. Divide the Year and its fourth by 7, and Subtract the remainder from 7, which will give the Index of the Letter from A.

But because, according to the Gregorian Calendar, every fourth Hundredths Year is Bissextile or Leap Year, and the other next Hundredths, as 1800, 1900, 2100, 2200, 2300 &c, are accounted common Years, consisting of 365 Days, and consequently have each but one Dominical Letter, which, according to the Julian Calendar, would have two; therefor the course of the Dominical Letters will be changed, and consequently this method of finding the Dominical Letter will only hold good for this Century; after which a Number must be added to the Year and its fourth, in order to find the Dominical Letters for ever; for which purpose take the following Rule, Viz.

Reject the Figures or Cyphers to the place of Hundredths: Divide the remaining Figures or Cyphers by 4; from this Quotient Subtract 1; and this Number Subtracted from the Century or hundred Years, and then this last remainder taken from the least Number of Sevens possible, leaves a Number which must be added to the Year and it's fourth, in order to find the Dominical Letter.

EX: What will be the Dominical Letter for the Year 1842? This Question, by the above Rule, will be solved in the following manner. Viz. 18÷4=4, and 4−1=3, and 18−3=15, and 21 the nearest Sevens −15=6 the Number to be added. Then 1842+461 its fourth +6=2308, and 2308÷7=329+5, which five is the Index of the Letter in a retrograde order from G; or 7−5=2 the Index of the Dominical Letter from A, Viz B.

To find Easter according to New Style.

Subtract the Epact of the Year proposed from 74: from the remainder, when less than 61, Subtract 31; but when more than 61, Subtract 61: this last remainder will be Easter Limit, or the paschal full Moon; and the Sunday after is Easter Day. Only observe, that when the last remainder is less than 20 it is in April; when it is 20 or exceeds 20, it falls in March, and in this last Case 1 must be added to the Limit found as above. — EX: When is the Paschal full Moon for the Year 1760? Ans: 74−12=62, and 62−61=1, which is April 1st — and the Sunday after being the 6th is Easter Day.

N: B: This Rule holds good till the Year 1899.

Rule to find Easter for ever, according to New Style, Golden Number and Epact being given.

Subtract the Epact of the Year proposed from 73: if the Remainder be more than 50, the excess is the Paschal-full-Moon in April; if it be between 50 and 60, both numbers inclusive, the excess above 29 is the Paschal-full-Moon in March; if it be less than 50, the excess above 30 is the Paschal-full-Moon in April: and the Sunday after is Easter-day.

Note, That always when the Epact is 24, Subtraction must be made from 72; and likewise when the Epact is 25 and the Golden Numbers between 12 and 19 both inclusive.

A Table shewing at one view the due order and progression of Time, adapted to the Old and New Style

Ex. To know what day of the Week Martinmas is in ye Year 1761. Look in the lowest Table on the left Hand for the given Year & the Letter directly above it is ye Dom: or Sunday Letter, which Letter look for in ye upper Table of the left Hand under the given Month of Novr. and in a direct line with it in the Table of Days and under ye 11th Day of the Month being Martinmas Day guiding your Eye downwards in the same Column till you are anent the Dom: Letter which is G you'll find in y^t Square ye Day required to be Thursday.

Days of the Month.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	.	.	.	.

Ex. To know what Day of the Week the 25th of March will fall upon in the Year 1761 New Style. Look in ye lowest Table on ye right Hand for ye given year and the Letter above it which is G is the Dom: Letter, which Letter look for in ye upper Table on ye right Hand below ye given Month over anent which in the Table of days and ye square below 25 nb you'll find in ye Table of ye Days of the Month, you will find the day required to be Sunday.

Days of the Week.

Jan: Oct^r:	May.	Aug	Feb: Mar: Nov^r:	June.	Sep: Dec^r:	Ap^l: July.							Jan: Oct^r:	May.	Aug:	Feb: Mar: Nov^r:	June	Sep: Dec^r:	Ap^l: July
A	B	C	D	E	F	G	Sun:	Mun:	Tues:	Wed:	Thur:	Frid:	Sat:	A	B	C	D	E	F	G
G	A	B	C	D	E	F	Mun:	Tues	Wed.	Thur:	Frid:	Sat:	Sun:	G	A	B	C	D	E	F
F	G	A	B	C	D	E	Tues:	Wed.	Thur	Frid	Sat.	Sun:	Mun:	F	G	A	B	C	D	E
E	F	G	A	B	C	D	Wed:	Thur	Frid:	Sat.	Sun:	Mun	Tues:	E	F	G	A	B	C	D
D	E	F	G	A	B	C	Thur	Frid:	Sat:	Sun	Mun	Tues	Wed:	D	E	F	G	A	B	C
C	D	E	F	G	A	B	Frid:	Sat:	Sun:	Mun:	Tues:	Wed:	Thur	C	D	E	F	G	A	B
B	C	D	E	F	G	A	Sat:	Sun:	Mun	Tues	Wed:	Thur:	Frid	B	C	D	E	F	G	A

Dominical Letters for Old Style.

C	B	A	G	F	E	D
1759	.	60	61	62	63	.
64	65	66	67	.	68	69
70	71	.	72	73	74	75
.	76	77	78	79	.	80
81	82	83	.	84	85	86
87	.	88	89	90	91	.
92	93	94	95	.	96	97
98	99	.	1800	1	2	3
.	4	5	6	7	.	8
9	10	11	.	12	13	14
15	.	16	17	18	19	.
20	21	22	23	.	24	25

Ex. To know what Day of the Week the 3^d Munday of July will fall upon in the Year 1761. Look for ye Dominical Letter in ye lowest Table on the right Hand which you'll find to be G which Letter look for in the ~~lowest~~ first Table on ye right Hand under the Month of July & in a line with this in the Table of Days look for Munday above which in the Table of ye Days of the Month in the 3^d Column you'll find the Day of the Month required to be the 16th.

Dominical Letters for the New Style.

G	F	E	D	C	B	A
1759	.	60	61	62	63	.
64	65	66	67	.	68	69
70	71	.	72	73	74	75
.	76	77	78	79	.	80
81	82	83	.	84	85	86
87	.	88	89	90	91	.
92	93	94	95	.	96	97
98	99	1800	1	2	3	.
4	5	6	7	.	8	9
10	11	.	12	13	14	15
.	16	17	18	19	.	20
21	22	23	.	24	25	26

To find the Julian Epact.

Multiply the Golden Number for the given year by 11; divide the Product by 30, and the Quotient will shew how many Embolismean or Intercalary Months have happened since the first year of the Cycle, and the Remeinder the Epact of that year. Thus, To find the Epact for 1751. The G. Num. is 4. Then $4 \times 11 = 44$. And $\frac{44}{30} = 1$ the Intercalary Month since the commencement of the Cycle + 14 the Epact for 1751.

To find the Gregorian Epact.

First find the Julian Epact, then subtract the number of days that the Gregorian, or New Style, has gained of the Julian, from the Julian Epact, and the Remeinder will be the Gregorian Epact; but, if Subtraction cannot be made, you must add 30, as often as needful. — Thus, for the year 1700. The Julian Epact 20 − 11 the number of days anticipated = 9 the Greg: Epact for that year.

To find how many days the Greg: Style has gained of the Julian. Write down the year; reject two figures or ciphers to the ~~left~~ right hand divide those on the left by 4, neglecting the Remeinder; add 2 to the Quote, and subtract their Sum from the figures cut off to the left hand, and the remainder gives the number of days anticipated. Thus In the year 1700. 4)17/00(4. And 4 + 2 = 6 ~~9 + 7 = +1~~ Then 17 − 6 = 11 the Number required.

But because this Rule will hold only till 1799, by the help of the following Table, the Epacts may be calculated for ever.

No.	Years of our Lord.	No. to be Sub.	No.	Years of our Lord.	No. to be Sub.	No.	Years of our Lord.	No. to be Sub.	No.	Years of our Lord.	No. to be Sub.	No.	Years of our Lord.	No. to be Sub.	No.	Years of our Lord.	No. to be Sub.
1	1600	10	13	2800	15	25	4000	20	37	5200	25	49	6400	0	61	7600	6
2	1700	11	14	2900	16	26	4100	21	38	5300	26	50	6500	1	62	7700	6
3	1800	11	15	3000	16	27	4200	22	39	5400	27	51	6600	2	63	7800	7
4	1900	12	16	3100	17	28	4300	22	40	5500	27	52	6700	3	64	7900	8
5	2000	12	17	3200	17	29	4400	22	41	5600	28	53	6800	2	65	8000	7
6	2100	12	18	3300	17	30	4500	23	42	5700	28	54	6900	3	66	8100	8
7	2200	13	19	3400	18	31	4600	23	43	5800	28	55	7000	4	67	8200	9
8	2300	14	20	3500	19	32	4700	24	44	5900	29	56	7100	4	68	8300	9
9	2400	13	21	3600	18	33	4800	24	45	6000	29	57	7200	4	69	8400	9
10	2500	14	22	3700	19	34	4900	24	46	6100	29	58	7300	5	1	8500	10
11	2600	15	23	3800	20	35	5000	25	47	6200	0	59	7400	5	2	8600	11
12	2700	15	24	3900	20	36	5100	26	48	6300	1	60	7500	6	3	8700	11

This Table is computed to the Period of 6900 years, which is numbered in the first Columns, or those marked No. from 1 to 69; the second Columns contain the intire hundred years from 1600 to 8700, and the third Columns the number which must be subtracted from the Julian Epact, in order to find that of the Gregorian. Whence the number to be subtracted from the Julian Epact, for any year between 1600 and 8700, may be found by Inspection only; but, if the given year should exceed the Limits of the Table, we must find the number of the Period applicable to it by the following Rule.

Add to the intire hundred the number 54, and if the Sum does not

Turn to next page at this mark (%)

Table of Climates by Riccioli.

Climate	Parallel	Height of the Pole	Longest Day	Climate	Parallel	Height of the Pole	Longest Day	Climate	Parallel	Height of the Pole	Con. Day in Nor. Lat.	Con. Night in N. Lat.	Con. Day in South Lat.
	1	2..59	12..15		15	46..33	15..45		29	66..2	15	12	14
1	2 M.	7..18	12..30	8	16 M.	48..15	16.. 0	15	30 M.	66..53	31	27	30
	3	11..29	12..45		17	51..14	16..30		31	67..43	45	41	44
2	4 M.	15..36	13.. 0	9	18 M.	53..46	17.. 0	16	32 M.	69..30	62	58	60
	5	19..33	13..15		19	55..55	17..30		33	71.. 8	77	71	74
3	6 M.	23.. 8	13..30	10	20 M.	57..44	18.. 0	17	34 M.	73.. 0	93	87	89
	7	26..50	13..45		21 M.	59..20	18..30		35 M.	75..56	108	101	104
4	8 M.	29..49	14.. 0	11	22 M.	60..39	19.. 0	18	36 M.	78.. 6	124	117	120
	9	32..48	14..15		23	61..47	19..30		37	81..10	139	132	135
5	10 M.	35..35	14..30	12	24 M.	62.. 4	20.. 0	19	38 M.	84.. 0	156	148	150
	11	38.. 9	14..45		25	64..12	21.. 0		39	87..40	172	162	164
6	12 M.	40..32	15.. 0	13	26 M.	65..10	22.. 0	20	40 M.	90.. 0	188	180	178
	13	42..41	15..15		27	65..43	23.. 0						
7	14 M.	44..42	15..30	14	28 M.	65..54	24.. 0						

In calculating the above Table allowance is made for the Effects of Refraction, which other Writers have neglected to do in their Tables of Climates: Refraction, by making the Sun appear higher than he is, keeps him longer above the Horizon of every place upon the Earth; and consequently makes the Artificial Day longer than it would be without Refraction.

In this Table, the Climates are distinguished by the Increase of half an hour in the longest Day, till it comes to be 20 hours; and from thence by the Increase of 2 hours, till it comes to be 24 hours; there the Month Climates begin, which are distinguished by the Increase of 15 days in the Length of the longest Artificial Day.

If to exceed 69, it is the number of the Period; but if it exceeds 69, divide it by 69, and it will be the number of the Period required. — Thus, If it were required to find the Gregg: Epact for the year 325, being the year in which the Council of Nice was holden, it will be 29. — For the entire hundred years are 3, to which add 54, and the Sum 57 is the number of the Period required. Find this number in the first Column marked N., and right against it in the 3 stands 4, the number to be subtracted from the Julian Epact. — Now the Julian Epact for said year 325 is 3, to which add 30 (because 4 cannot be subtracted from 3) and from the Sum 33 take 4, and the remainder 29 will be the Gregorian Epact required.

The larger Spaces of Time have some Distinction among Mankind are (1) A Lustrum, which is a certain Space of Time Antiently applied to Civil Uses, as Sacrificing, Taxation, letting Farms, &c, and though formerly it was reckoned to consist of five years, yet Chronologers do now reputte it only as four. (2) Seculum, a Century or Space of 100 years; though among the Antients they had a Natural Seculum, which they reputted to the longest Space of a Man's Life. (3.) Æuum an Age, a Space of Time indefinitely used for the Life or Age of a Man; sometimes for 100 years; and sometimes for Eternity. (4) The Olympiad, was a Space of 4 years, or 50 Months of 30 Days each. At the Expiration of each Olympiad the Olympic Games were Celebrated near the City Olympia in Honour of Jupiter Olympius. The Antient Greeks made all their Computations by the Years of the Olympiads.

A Cycle is (in plain English) a circle of Years, Months, Days, &c. Or, it is a perpetual Round or Circulation of any of the same parts of Time; so that the last returns upon and succeeds the first. Of Cycles, the following are famous and of frequent Use.

The Cycle of the Sun, or Solar Cycle, is a Cycle or a Revolution of 28 Years. This Cycle received both its Name and Origin from the seven Letters of the Alphabet A, B, C, D, E, F, G, which were placed in the Almanack to denote the Days of the Week in Order, from the first to the seventh throughout the Year. Now because one of those seven Letters must necessarily stand against Sunday, or the Lords Day, it was wrote in the Capital Form, and was called the Dominical Letter; the other side being put into small Characters.

Now since a Julian Year contains 365 Days, if that Number be divided by seven, there will remain one Day: If there had been no Remainder, 'tis plain every Year would begin on the same Day of the Week; but since one Day remains, 'tis as evident the Year must begin & end on the same Day of the Week, and therefore the the next Year will begin on the Day following.

If the first of January be on a Sunday, A will be the Dominical or Sunday Letter for that Year; then because the next

year

Year begins on Monday, the Sunday will fall on the seventh Day, to which is annexed the seventh Letter G, which therefore will be the Dominical Letter for that Year: Also the next Year after will begin on Tuesday, and the Sunday will fall on the sixth Day, therefore the sixth Letter F will be the Sunday Letter for that Year: Whence 'tis plain the Sunday Letters will go in a retrograde Order thus, G, F, E, D, C, B, A, G, F, &c. And in the Course of seven Years (were they all common ones) the same Days of the Week and Dominical Letters would return to the same Days of the Month.

But because in a Bissextile Year there are 366 Days, there will be 2 Days over & above the 52 Weeks; if that Year should begin on a Sunday, it will end on a Monday, and the next Year would begin on a Tuesday, the first Sunday of which would fall on the sixth of January, to which is annexed the Letter E, and not G as in common Years. By this means, the Bissextile Year returning every fourth Year; the Order of Dominical Letters succeeding each other is interrupted, and the Series does not return to its first State, till after 4 times 7, or 28 Years; which Period therefore is the Cycle of which we are discoursing, and when compleated the Days of the Month return in the same order to the same Day of the Week.

In every Bissextile Year there are two Dominical Letters; the first of which takes place to the end of February; and the other the rest of the Year.

This Cycle is not exactly true and just to the Motion of the Sun, as is before observed; since the Julian Year does not quite contain 365 Days 6 H. for the Sun finishes his Course in 365 Days 5 H. 49, and therefore begins again his Course or Round 11 Minutes before the Civil year is ended. And thus every Year will begin 11 Minutes sooner than by the Julian Account. Hence, if at the Council of Nice, A. D. 325, the Equinox fell on the 21st of March, it would after 131 Years fall on the 20th, after 262 Years on the 19th; and thus, after 1310, or A. D. 1635, it must fall on the 10th of March; which Pope Gregory XIII observing A. D. 1582, made the Correction before related; and is now Received in Great Britain.

But even the Gregorian Emendation is not the strict

Truth

Truth; for the 11 Minutes in 400 years make 3 D. 17 H. 20'. But the 17 H. 20' was neglected, which in 18 times 400, or 7200 years, makes a whole Day; and therefore no less a Cycle than of 7200 years will restore the first Agreement between the Calendar and the Solar Motions.

The Ninth year of the Solar Cycle was past when the first year of the Christian Computation commenced; therefore in Order to find the year of the Cycle for any year of Christ, proceed thus. Add 9 to the given year, and divide the Sum by 28; the Quotient shews the Number of Cycles that have revolved since the Year of Christ, and the Remainder is the Year of the Cycle; but if there be no Remainder, the Present Year is the 28th or last Year of the Cycle.

To find the year of the Solar Cycle.

To find the Dominical Letter for each Year of this Cycle, see the Table Page 21th, where the first Column to the left hand contains the several Years of the Solar Cycle, over against which in the right Hand Columns are the Dominical Letters answering to them. The Column marked 1 on the Top serves the Julian Account or Old Stile for ever. The other Columns are for the New Stile; and the Column of Letters above each Hundredth Year marked at the Top serves it and all the intermediated years to the next hundredth: As the Column marked 2 at the Top serves from 1700 to 1800, and the Column marked 3 from 1800 to 1900 &c. The Hundredth Years may be enlarged as far as you will, by observing the Order of those already marked at the Foot of the said Table.

The Metonic Cycle is next in Consequence and Importance; It is thus called from its Inventor Meton, or Meto, an Athenian, who first published it at Athens in the year before Christ 432. He called it Enneadecaeteris, or Cycle of 19 years, which we since call the Lunar Cycle, or Cycle of the Moon; the Numbers of which being of excellent Use, were written in Antient Calendars in Letters of Gold, whence they came to be called Golden Numbers and Primes.

This Lunar Cycle was invented to shew the Change of the Moon, and the Time of Easter and other Moveable Feasts; and that by means of those Numbers they called Epacts. These Epacts are (as their Name implies) Added Numbers; that is, a Number

Of

Of Days added to the Lunar Year, to make it even or equal to the Solar Year.

	D.	H.	′	″
The Solar Year contains	365	5	48	57
And the Lunar contains	354	8	48	38
The Difference is the Epact	10	21	00	19

Now as this Difference wants but 3 Hours of 11 Days, the Ancients took no Notice thereof, but made the ~~Year~~ Epact of the first Year of the Cycle 11 Days; whence the Epact of the second Year would be 22 Days, the Epact of the third 33; but for each 30 Days they intercalated a Month, and reckoned the Odd 3 Days the Epact for that Year; and thus proceed by adding 11 Days, and intercalating a Month for every 30, till at the end of 19 Years, nothing remaining of the former Epact (which for the last, or 19th Year, is always 12) there began a New or Second Revolution of the Epacts & Golden Numbers.

But notwithstanding all their Care of Epacts & Embo:=lismic Months, this Cycle is still defective. For the Epact of 11 Days exceeds the true Epact of 21 D. 11, by 2 H. 49′, which in 19 Years make 2 Days 5 Hours. To equibalance this Excess, the 7 Embolismic Months were made to consist of 30 Days each, which is more than the Synodical Month by 11 H. 15′ 51″. This Excess, multiplyed by 7, makes 3 D. 6 H. 31′. But this again over-balances the former Excess by 25 H. 31′; & therefore by allowing 12 Days instead of 11 for the Epact ~~of the last Year~~ of the last Year of the Cycle to answer this 25½ odd Hours, 'tis plain the Solar Year will, at the end of the Cycle, be greater than the Lunar Year, by about 1 H. and 31′.

But though this Deficiency of the Cycle be small, yet in Time it becomes very sensible; for by this Analogy 1½ : 19 :: 24 H. 304; 'tis plain, in the Space of 304 Years it amounts to one Day. Now the Council of Nice, A. D. 325, fitting this Cycle of the Moon to the Calendar, it did nearly enough, for some time, give the New Moons. ~~But the Lunations~~ But the Lunations in every 304 Years anticipating a whole Day, and since the

Said

Said Council have passed 4½ times 304 years, the New Moons happen sooner by 4½ Days at this time by the Golden Numb: -ber, than they really do in the Heavens.

In the first year of Christ, the Golden Number was 2; therefore to the current year of Christ add 1, and divide the Sum by 19; the Remainder (neglecting the Quotient) will be the Gold: -en Number for that year.

To find the Golden Number for any year of Christ.

From the Cycles of the Sun & Moon multiplyed into one another arises another Cycle or Period of 532 years (for 28 by 19 gives 532,) which was invented by Victorius a Presbyter of Limoges in Aquitain, by order of Hilary Bishop of Rome, and is therefore called the Victorian Period; after the Expir: -ration of which he supposed all the New and Full Moons, the same times of Easter, and the same Dominical Letters would come over again in the same order of Time as in the former Cycle, and so on in all following Cycles for ever. This was fi: -nished and first published in the Year of our Lord 457.

Afterwards, in the year 527, Dionysius Exiguus, a Roman Abbot, corrected in some particulars, and it was cal: -led Dionysian Period from him; as also the great Paschal, because the Western Churches went by it for many Ages, till Pope Gregory XIII new modeled it. To find the year of the Dionysian Period for any given year of Christ, to the the Current year add 457, and divide the Sum by 532, what remains is the year of the Period sought.

To find the year of the Victorian Period for any given year of Christ.

There is another Period of 76 years, invented by Calip: -pus Cyzicenus of Mysia, and therefore called the Calippic Period. He supposed the Excess of the Solar year above the Lunar at the end of the Metonic Cycle of 19 Years, would in the Course of those Cycles, or 76 years, amount to a whole Day and so cast away a Day in every such Periods of 76 years. But herein he was greatly deceived, for the Excess of the Solar above the Lunar year in one Cycle

To find the Calippic Period

To but 1½ Hour, and therefore in 4 Cycles, or 76 Years, could amount to but 6 Hours instead of 24. Wherefore the Error of this Period is a Deficiency of 18 Hours nearly.

This gave Occasion afterwards to Hipparchus of Nicea in Bithynia to make a New Correction of the Meto:nic Cycle; for he observing that the Callippic Period was laid too great by a Quarter of a Day in the Solar Motions, he multiplyed it by 4, which produced a New Period of 304 Years: and therefore in every 304 he deducted a whole Day, that the Moon might come again to the old Place in the Calendar. And this is very near the truth, and much the same with the Gregorian Correction, or New Stile, made many Ages after.

The Romans made use of a Cycle, called the Cycle of Induction, which had no Relation to the Celestial Motions, but was used for Civil Purposes, the Chief of which was to indicate or make known the Time of certain Payments made by the Roman Subjects to the Republic. It consisted of 3 Lustrums, or 15 Years; and was established by Constantine, A. D. 312, in the Room of the Greek Olympiads. To find the Year of this Cycle, subtract 312 from the given Year of Christ, and divide the Remainder by 15; and neglecting the Quotient, what remains is the Year of the Indiction sought.

From the Multiplication of the Cycles of the Sun, Moon, & Indiction arises the famous Period, called the Julian Period from Julius Scaliger the reputed Author thereof. This Period consists of 7980 Years, (for 28 by 19 gives 532; and that by 15 gives 7980.) This Period had its beginning fixed to the 764th Year before the Creation, and is not yet compleated; and therefore comprehends all other Cycles, Periods, and Epochas, and the Times of all Memorable Actions and Histories. There is but one Year in the whole Period that has the same Numbers for the three Cycles of which it is made up: And therefore if Historians had remarked in their Annals the Years of the respective Cycles, there had been no Dispute about the Time of any Action.

The first of Christ was the 4714th Year of the Julian

Period

Period; and therefore if to the Current Year of Christ 4713 be added, the Sum will be the Year of the Julian Period. So the Year 1753 will be found to be the 6466th of the said Period.

There is another called the Constantinopolitan Period, which is of the same Length or Number of Years as the Julian Period, viz. 7980; but it neither begins at the same time, nor have the Cycles of the Sun & Moon the same Situation in both; for the first Year of the Solar Cycle in the Julian, is the 12th in this; and the first of the Lunar is the 17th here; the Cycle of Indiction is the same for the most part in both. This Period is used by the Greeks, as the Julian is by the Latins, or Roman Historians.

Epocha or Æra is a certain Term or fixed Point of Time, made famous by some memorable Accident; from which, as from a Root, we make our Calculations and Computations of Time; and all remarkable Actions are disposed & recorded according to the Series of years which follow from such a Root or Epocha. The principle Æra's are those of the Creation, of the Olympiads among the Greeks, of the Building of Rome; that of Nabonassar, the Death of Alexander, the Adjoining Æra of Martyrs, the Arabian Hegira, the Persian Jesdegird, the most famous Æra of the Birth of Christ; and that which contains them all, the Julian Period above explained. All these Epochas & Æras, together with several others of less Note, have, in the following Table, their beginings reduced or fixed to the years of the Julian Period, the Creation of ye World, and to the years before & after Christ.

		Julian Period	Year of the World	Year before Christ
1.	The Creation of the World, after the Jews.	952	J	3760
2.	The common Epocha of the Creation	765	J	3950
3.	The same by the Greek Emperors	787	J	3926
4.	The same in Mr Bedford's Scripture Chronology.	706	J	4007
5.	The Deluge, or Noah's Flood	2362	1657	2351
6.	The Assyrian Monarchy by Nimrod	2665	1960	2048
7.	The Birth of Abraham	2714	2009	1999

5.	The Israelites 400 years Servitude in Egypt	2819	2114	1894
9.	The Kingdom of Argos founded by Inachus	2857	2152	1856
10.	The Kingdom of Athens founded by Cecrops	3151	2452	1556
11.	The Israelites Departure out of Egypt	3219	2514	1494
12.	Their Entrance into Canaan, or the Jubilee	3258	2553	1455
13.	The Distruction of Troy	3530	2825	1183
14.	The first Sabbatical year	3260	2557	1451
15.	The Jewish High-Priesthood	3300	2603	1405
16.	King David's Reign	3646	2941	1067
17.	The Foundation of Solomon's Temple	3698	2993	1015
18.	The Epocha of Nabonassar	3966	3261	747
19.	The Olympiads	3938	3233	775
20.	The Building of Rome	3962	3257	751
21.	The Destruction of the Kingdom of Israel	3992	3287	721
22.	The Babylonish Captivity	4108	3302	606
23.	The Distruction of Solomon's Temple	4120	3421	587
24.	Cyrus the Founder of the Persian Monarchy	4178	3472	536
25.	The Battle at Marathon	4223	3517	491
26.	Xerxes's Defeat at the Battle of Salamis	4234	3528	480
27.	Meto began his Cycle	4282	3576	432
28.	The Beginning of the Peloponesian War	4283	3577	431
29.	Daniels Seventy Weeks of years began	4269	3564	444
30.	The Beginning of the Calippic Period	4383	3677	331
31.	The Death of Alexander	4390	3684	324
32.	The Grecian Epocha of the Seleucidæ	4402	3695	312
33.	The Æra of the Asmoneans or Maccabees	4548	3841	166
34.	The Antiochean Epocha	4665	3958	49
35.	The Correction of the Calendar by Julius Cæsar	4669	3962	45
36.	The Beginning of the Reign of Herod	4677	3970	37
37.	The Spanish Æra	4676	3969	38
38.	The Battle a Actium	4683	3976	31
39.	The Epocha of the Title of Augustus	4687	3980	27
40.	The true Birth of Christ	4710	4006	4
41.	The Vulgar or Dionysian Year of Christs B.	4714	4009	A. C.
42.	The Passion or Death of Christ	4746	4045	33
43.	The Destruction of the City of Jerusalem	4783	4078	70
44.	The Diocletian or Æra of Martyrs	4997	4292	284
45.	The Epocha of Constantine the Great	5019	4314	306
46.	The Council of Nice	5038	4333	325
47.	The Encænia of Constantinople	5043	4338	330
48.	The Epocha of the Hegira	5335	4610	622
49.	The Epocha of Yesdejerd	5345	4620	632
50.	The Jellalæan or Gellalean Epocha	5192	5661	1079
51.	The Epocha of the Reformation	6230	5505	1517

FIGVRA. IV

FIGVRA. I

♈ Aries.	♉ Taurus.	♊ Gemini.	♋ Cancer.	♌ Leo.	♍ Virgo.
21. MARTII.	21. APRILIS.	22. MAII.	22. IVNII	23. IVLII.	23. AVGVSTI.

♎ Libra.	♏ Scorpius.	♐ Arcitenens.	♑ Caper.	♒ Amphora.	♓ Pisces.
24. SEPTEMBRIS.	23 OCTOBRIS.	23. NOVEMBRIS.	22. DECEMBRIS.	21. IANVARII.	19. FEBRV.

ORIENS

Subso-lanus.

Caecias.

Eurous.

Bo-reas.

SEPTEN TRIO.

Septem trio.

Circius

Africus

Aus-ter.

Aus-tro-Afri-cus.

Fauo-nius.

Zephy-rus.

OCCI-DENS.

Aus-tro-cus.

Declinatio

D.M.OR.

P.

D.

40

30

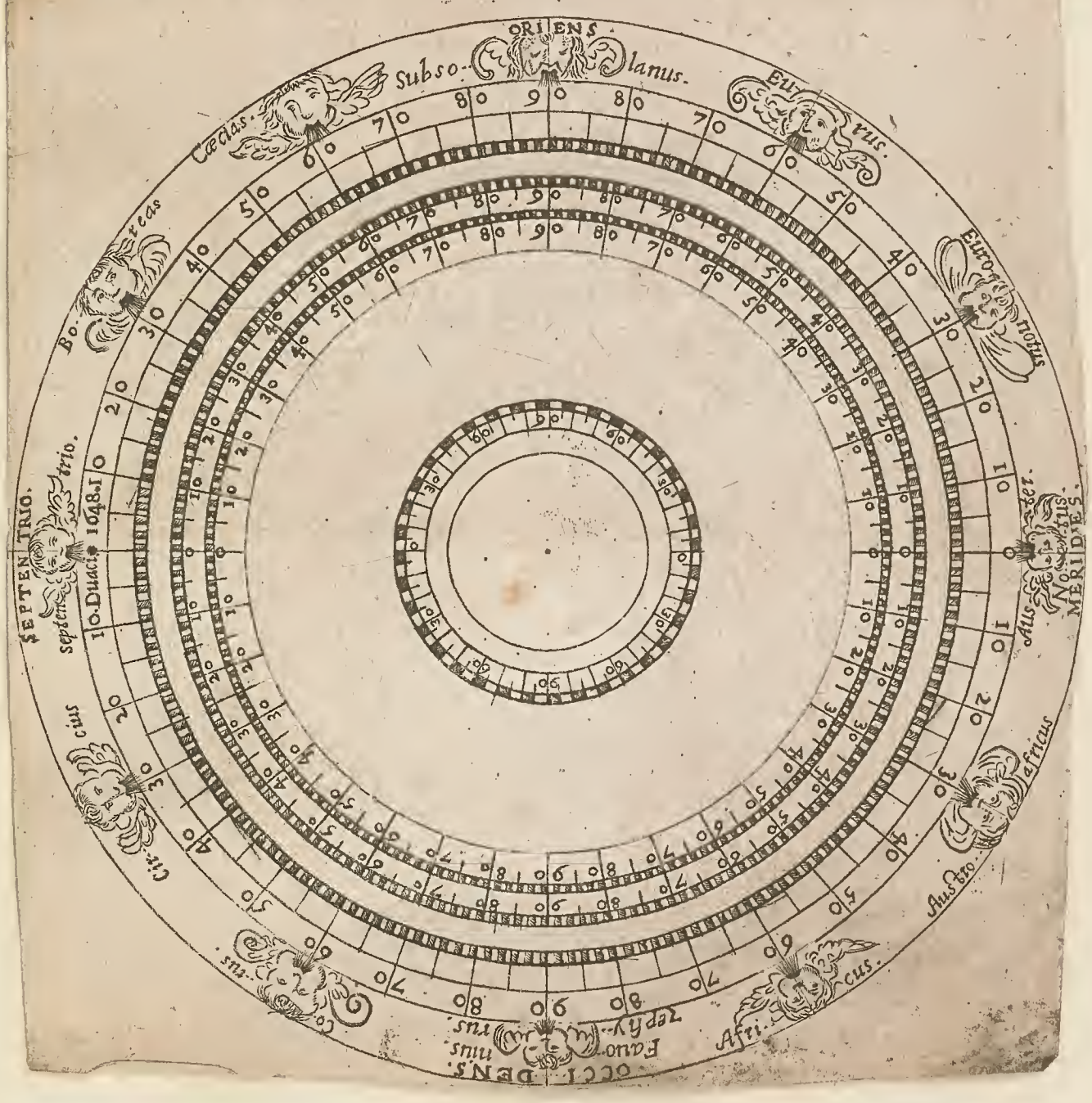
Meridies.

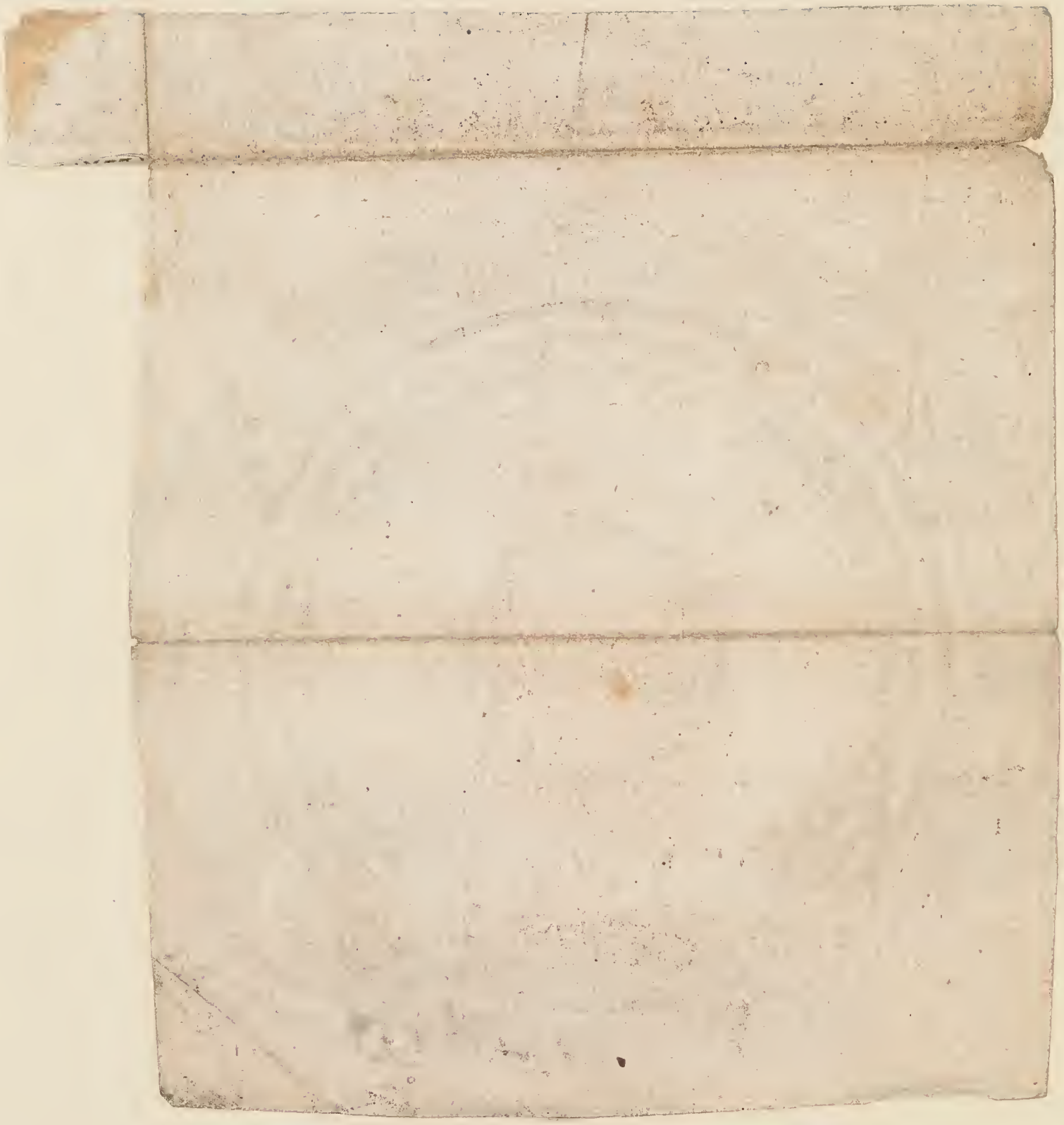
Aquilo.

Vers Orient

♈ Aries.	♉ Taurus.	♊ Gemini.	♋ Cancer.	♌ Leo.	♍ Virgo.
21. MARTII.	21. APRILIS.	22. MAII.	22. IVNII	23. IVLII.	23. AVGVSTI.

♎ Libra.	♏ Scorpius.	♐ Arcitenens.	♑ Caper.	♒ Amphora.	♓ Pisces.
24. SEPTEMBRIS.	23 OCTOBRIS.	23. NOVEMBRIS.	22. DECEMBRIS.	21. IANVARII.	19. FEBRV.





LE CADRAN DES CADRANS

IHS

MA

Declinaison du Midy vers Occident

Declinaison du Midy vers Orient

Declinaison du Septentrion vers Orient

Declinaison du Septentrion vers Occident

FIGVRA. I

FIGVRA. II

FIGVRA. III

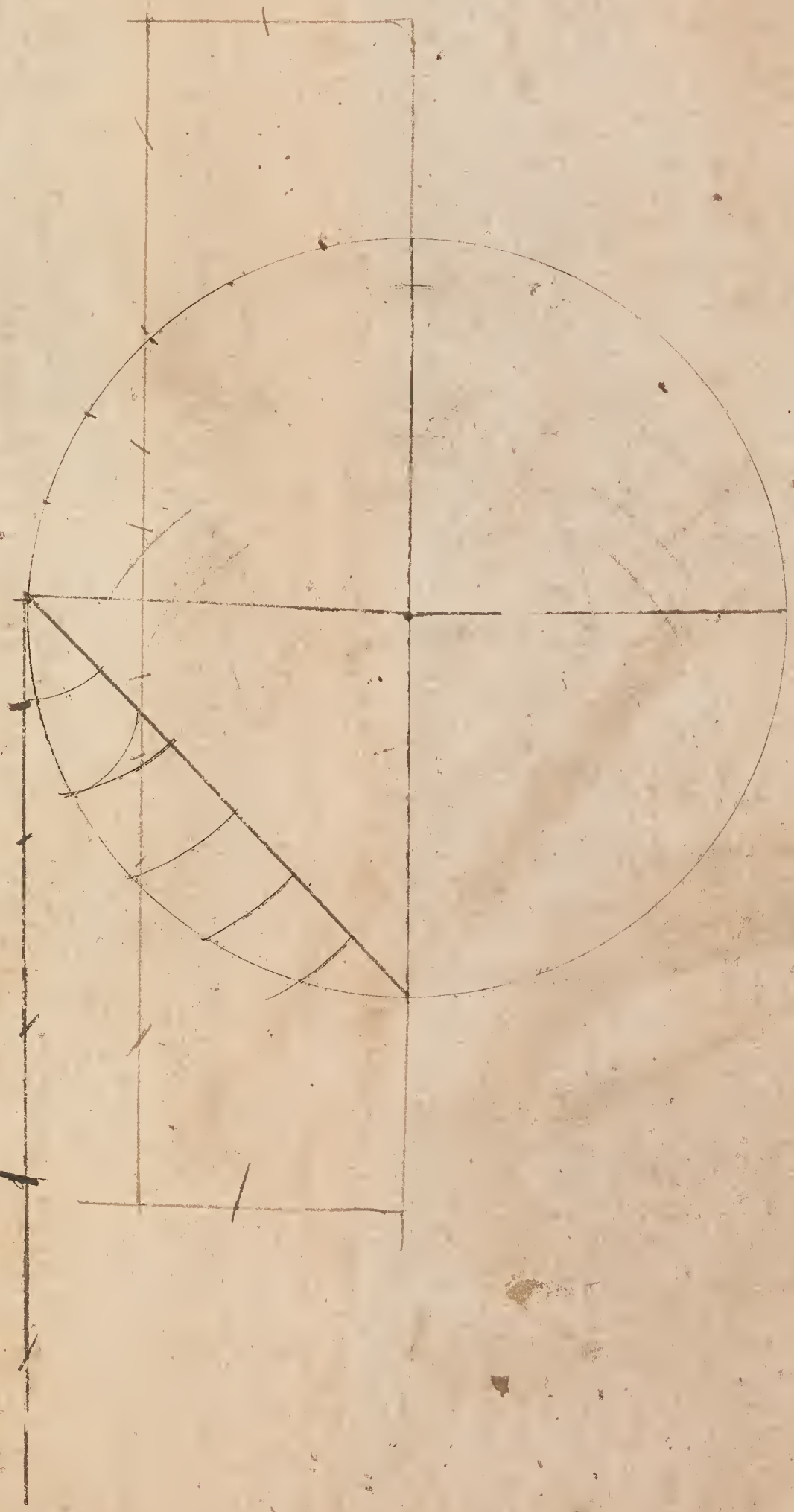
FIGVRA. IV

FIGVRA. V

DVACI 1645.

Gradus signorum superiorum

Gradus signorum inferiorum

Declinatio partium eclipticæ, et Tangens G. M

Altitudo solis per singulas horas ad elevationem Grad. 50.